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THE SPRING FLOWERS OF COLORADO.

BY E. L. GREENE.

It is the tenth of April, and although the skies are clear, and the sun's rays warm enough for early June, yet the Colorado landscape shows no indications of spring. The mountain range which fills the western horizon, is still clad in all the dazzling white of wintry snows, and remains a picture of beauty and sublimity quite indescribable. The plains are brown and bare, as they were during most of the winter. Here and there, tufts of the evergreen Soap-weed (*Yucca angustifolia*), or matted masses of Prickly Pear, show their perennial verdure, and furnish the only conspicuous signs of plant life. No April showers have fallen to revive the grasses, and the herds of long-horned Texas cattle graze contentedly upon the sere remains of last year's growth. Yet at this early date, there are wild flowers, modest, and lovely April flowers, for the eye that knows where to look for them.

Extending all along the eastern base of the Rocky Mountains, is a series of high and picturesque table-lands, and below and among them, numerous grassy hills and knolls, all destitute of trees, often rocky, and apparently as barren as are the plains around. On sunny slopes, and in sheltered nooks among these foot-hills, we find our earliest flowers. By the first week in April, there appears on the very summits of these grassy knolls a real beauty, which, as it yet lacks an English name, may bear its Latin one, Townsendia (*T. sericea*). The plant belongs to the family

of Compositæ, an order which has not the charm of furnishing many early flowers, but which displays its beauties in late summer or in autumn. Even our Townsendia forms its flower buds and its foliage in the fall. The plant is almost destitute of a stem, and the narrow silky leaves form a dense tuft two or three inches broad, just upon the surface of the ground. Nestling closely among the pretty leaves are five or six rather large daisy-like flowers. The rays are either white or rose-color, and the center of each head is yellow, as is commonly the case in the compound flowers. There grows with this another species of Townsendia (*T. Fendleri*), smaller and more delicate, with more numerous heads, but it flowers nearly a month later. These very pretty plants are well worthy of a place in our gardens, though they would perhaps be difficult to rear in any other than their native localities. By the fifteenth of the month *Viola Nuttallii* appears on the sunny hillsides, a fine yellow violet, with its petals prettily painted outside with reddish brown. With it *Mertensia obtusifolia* hangs out its pendant clusters of light blue.

Passing beyond the foot-hills and entering some mountain gulch or cañon, we find the rocky slopes all yellow in some places with the flowers of the Rocky Mountain Barberry. Though a congener of the barberry of the Eastern States and Canada, it is a trailing evergreen shrub, and the flowers are succeeded by handsome blue berries like frost grapes. This is *Berberis aquifolium* of the authors. Higher up among the rocks are the large pale purple flowers of *Anemone patens*, one of the finest of Rocky Mountain plants, but it is quite common as far eastward as Wisconsin, on bleak, gravelly hills. With it in the mountains of Colorado, grows a modest little cruciferous plant with white flowers (*Thlaspi Fendleri*); also a peculiar species of crowfoot (*Ranunculus glaberninus*), all of which are among the first flowers to appear.

By the twentieth of April, the zealous flower hunter will be amply rewarded for his toil, if he ventures to the top of some one of the table mountains. The task will indeed not be an easy one, for many tiresome stages must be made, up steep declivities, and among sharp and rugged rocks, and over what from the base may seem almost insurmountable, the high and almost unbroken wall of perpendicular rock, which invariably encircles the summits of these table mountains. High among these sublime formations, which stand pictured against the sky, like giant castle works, wild

birds of bolder wing construct their homes securely, and from many a dark recess the melancholy owl pours forth her plaintive wailings upon the ear of night. Yet these mighty barriers are not altogether impassable. Among the irregularities of their outline are places where little streams bordered with shrubs and bushes come singing down among the rocks, from the table land. Even broad and easy passage ways may be sought out by the eye before commencing the ascent.

These table lands, when reached, are usually found to present an uneven surface of bare rock, or, in places, of shallow soil. There are even extensive meadows on some of them with occasionally a pond of water. In sheltered situations opening toward the south where the spring sun first drove away the snow, there are already some real treasures for the botanist's portfolio. In every crevice and hollow, where there is a little soil, we find a very handsome cruciferous plant which has yet no name by which to be known, save the Latinized Greek one, *Physaria didymocarpa*. Its pretty rosettes of broad whitish leaves, which lay all winter close to the frosty rock, have now sent up a number of spreading stems with golden yellow flowers. A small variety of *Thermopsis fabacea*, with fragrant lupine-like blossoms, will be found where the soil is deeper, but the larger and more common form of this plant flowers a month later, on the plains below.

The most interesting tenant of these heights is the *Echinocactus Simpsonii*. As its name would indicate, it belongs to the cactus tribe. It is remarkable among the cactaceous plants of this latitude for its early flowering. Not less than a dozen species or varieties of these plants, grow upon the adjacent plains, but none of them are in flower before the first of June. This one may be found in perfection before the last of April. It is globose in form and very thickly armed with whitish spines, so that, when out of flower, the plants seem like mere balls of bristles scattered about among the rocks. The flowers are five or six in number, of a bright purple, forming a circle around the centre, or rather, apex of the plant. It is an object of very singular beauty, alone well worth the trouble and fatigue of an hour's climbing.

As the first of May draws nigh, the general aspect of the country becomes more springlike. The grasses are beginning to grow, and the number of flowers begins to increase so that to enumerate them would be tedious. However, we must not fail to notice a

very beautiful, low liliaceous plant with grassy foliage and crocus-like flowers, which now begins to whiten the hill-sides nearest the plains. Its name is *Calochortus venustus*, and it deserves its name, which, equally for the species and the genus, refers to its beauty.

PRAIRIE FIRES.

BY DR. C. A. WHITE.

Every dweller in the great interior region of North America, is more or less familiar with prairie fires, or rather, they have often at nightfall seen their lurid light in the distant horizon, or by day their huge volumes of smoke rising and blending with the clouds, and many are even familiar with the consuming march of the flames themselves. Strangers visiting these regions, between October and May, are often alarmed at the first sight of these illuminations, being impressed with the belief that they emanate from burning buildings.

Usually, these fires are harmless, but there is always danger that they will cause destruction of property, and even of life, and the settler in sparsely inhabited districts watches with anxiety until the almost inevitable annual scourge has swept all the uncultivated prairie in his neighborhood. The greater part of the combustible material which feeds these fires is grass, the remainder being the dried remains of those annual plants so well described by Mr. J. A. Allen, in the Naturalist for December, 1870. These together cover the ground every season, for the fires of one year do not at all impair or prevent their abundant growth the next. Stringent laws are enacted in all the prairie states, against the setting of fires to the prairies, yet each year's growth of grass upon at least the larger ones, is somehow almost invariably burnt. The progress of the fire is usually slow, and is often arrested by a few furrows plowed around the field for that purpose, by small rills or even by a slightly beaten road. But when the wind is high upon the great prairies, the case is very different. Then nothing can withstand the fury of the fire, and it often runs an unchecked course of more than a hundred miles, sometimes leaping rivers of more than a

dozen rods in width, since their valley sides are often grassy down to the water's edge. In such cases, woe to the traveller who may be unprepared for, or may lack nerve to meet the emergency. If he has a box of matches and ordinary coolness of judgment he is in no personal danger, for he has only to stop and set another fire, extinguish that part of it upon the windward side before it has increased beyond his control, and pass into the space that has been burnt free from grass by his own fire, where he is safe from the advancing flames that have given him the alarm. Some danger, however, always remains that his animals may take alarm from his own fire, and become unmanageable, but usually their instinctive dread, and a sense of dependence upon their masters, which horses constantly feel and manifest upon those lonely journeys, render them usually quite tractable under such circumstances.

While prosecuting the Geological survey of Iowa, we were often exposed to danger from fires when having occasion to cross the broad prairie region of the western part of the state. One October day after the first frosts of the season had killed the herbage, and the subsequent warm days had rendered the prairies almost like one vast tinder-box, the approach of night found us a few miles from a stream, the valley of which was distinctly in view as well as the broad prairie stretching beyond it. Mosquitoes are abundant in the valleys at this time of the year, and being apparently conscious that their end is approaching, they seem determined to get the greatest amount of blood in the shortest possible time from every living thing that comes in their way. We, therefore, stopped as usual, upon elevated ground, to camp where the breeze would prevent their visit. Procuring water for the camp, and watering our horses at a rill near by, we pitched our tent where we could overlook the surrounding country, and mowed the grass from a space of a few square yards upon which to build our camp fire of the few sticks we had brought from our last camping ground. Our supper over, and the horses picketed upon the grass that was still fresh by the rill, we lay down to sleep. The wind had been high all day, and did not abate upon the approach of night as it usually does. As it began to grow dark, I had observed in the distant horizon the light of a prairie fire. It was directly to the windward, and the face of the country in that direction was known to be such that nothing would be likely to arrest its progress towards us, except the stream before mentioned, and this I feared was too narrow

for that purpose in so high a wind. An hour was passed nervously watching the progress of the light and listening to the moaning of the wind, as it roughly swept the newly frost-killed grass. At last I could distinctly see the fire making its way down to the stream upon the further valley side; then for a time its light seemed to be gone, and I hoped its progress had been stayed by the water of the stream, but in a few moments more it had gained the top of the hither valley side. No time was now to be lost, so quickly arousing my companions, and bidding them follow me with their blankets, I seized a brand from the camp-fire and running a few rods to the leeward, a moment sufficed us to start a new fire from our camp, its progress towards it (for it will sometimes work its way slowly against the wind) being arrested by the beating of our blankets. One man then leading the horses into the burnt space, we followed, dragging tent, bedding, harness and camp-chest; then seizing the wagon, which was fortunately upon inclining ground, we rolled it safely in by the light of the fire we had kindled and also of that which was fast approaching us. Scarcely had we secured the last article and passed within the charmed circle, when the dense flames, leaping high in the air and rolling like surf upon the sea-shore, gathered around us, and enveloped us with their hot and suffocating smoke. We all, horses and men, stood there motionless; conscious of our safety it is true, but with an instinctive feeling of terror at the danger we had escaped. We were upon a hollow island in a sea of fire. A moment more, and it was a peninsula, for the advancing fire-flood parted around us; and then we were left in the darkness, intensified by the blackness of the charred earth, while the flames swept on over the distant prairie, like a troop of flying fiends.

Gathering our scattered equipage together, we lay down again for the night, with no regret except that our faithful horses could not have their accustomed grazing. Next morning found us in the midst of a dreary blackened waste, not "without the smell of fire upon our garments," but we were free from similar danger until we should reach a region of unburnt prairie.

SOMETHING ABOUT SEEDS.*

BY W. W. BAILEY.

By simply calling attention to the many beauties of these little organs, I hope to induce the youthful student to follow further in that pleasant path which I shall merely indicate.

A few months since I was reading with a tear in one eye for the misfortunes of the French, and a twinkle of merriment in the other, at the adventures of their ubiquitous war minister, when my breath disturbed the seed of an Asclepias (*A. incarnata*), by accident reposing on my table, and it floated on a voyage of discovery to a distant corner of my room. "Monsieur Gambetta!" I exclaimed, "Here is your original aëronaut! No balloon or parachute of man's invention can compare with the tufted silk which floats this little voyager! Fearlessly he trusts himself to the breezes, now for a moment touching on some interposing obstacle, then lightly sailing off again to bear his freight of life to the position chosen for its home."

And now the flossy seedkin has come into our lines, and shall not be released until he passes a satisfactory examination. Where are you travelling, little stranger, and what is the cause of your hurry? Can you not tell us something of your balloon itself, and of your purpose in trusting to the winds? After an ineffectual effort to soar beyond my reach, the imprisoned seed reveals his secret, and in so far as I can interpret his peculiar language, his story is as follows: —

The seed of Asclepias, or milkweed, is thin, flat, and of a brownish tint. The embryo is devoid of that store of albumen which many plants provide for the early sustenance of their young. It, with its fellows, is imbricated upon a papery placenta, its plumy tufts reposing in gill-like processes of the same until the perfection of the fruit, when they become disengaged by the lightest touch, and waft the attached seed to its destined resting-place. Nothing can be more soft and satiny than is the so-called coma of Asclepias. Under the microscope the hairs are found to be exceedingly smooth and regular in outline, and undistinguished

* A paper read before the Franklin Society, of Providence, R. I.

by the spiral twisting which characterizes many similar fibres. The evident design of the plumes, as in other cases where seeds are provided with such appendages, is to assist in the wide-spread distribution of the species. Many seeds probably fall quite near the parent plant, but chance breezes carry others often to a very great distance.

Some one is already wondering, doubtless, why I have not taken the more familiar dandelion for illustration. It is simply because, as I have said, the Asclepias happened to be upon my table. As every one knows, the dandelion (Taraxacum), the groundsel (Senecio), the thistle (Cirsium and Onopordon), and many other genera of Compositæ, the willows (Salicaceæ), some of the buttercups (Ranunculaceæ), the evening primrose family (Onagraceæ), together with members of many other orders, are similarly endowed with silky tufts to assist the seed in its migrations. The execution may differ in diverse species, but the plan remains the same. This is the commonest, yet other methods are adopted to obtain the same end, as we notice in the key-like samara of the maple and the winged seeds of the trumpet creeper (*Tecoma radicans*), of the pines and the elms. All these are charming objects viewed by the unassisted eye, or more closely examined by means of the microscope.

I cannot dismiss this portion of my subject without dwelling for a few moments upon the means provided for the scattering of seeds. Some plants, like the balsam (Impatiens) and the geranium, by a sudden contraction of portions of the capsule, expel the contents with a jerk, which often throws them to a considerable distance. Others are provided with little hooks, claws, fine hairs, or some other mechanical means of attaching themselves to moving objects and availing themselves of their involuntary aid. There is no American botanist, probably, but has expostulated mildly with the chain-like pods of Desmodium, which will persist in adhering to one's clothing, and the removal of which is no small task. The barbed achenium of *Bidens frondosa* is another pest to man, as are the burs of *Lappa major*, or burdock, to sheep and cattle, but we must bear in mind that in the case of these plants, we are merely mediums of conveyance, and have temporarily resigned our proud position at the head of nature.

Animals and birds often distribute seeds which have passed through the system undigested; currents of water in the ocean

bear them from one island or continent to another, while commerce, often unintentionally, scatters them over distant lands. In this latter way, many of the most pernicious weeds have spread from Europe into Australia, America and India, where they make themselves perfectly at home, and evince frequently even more vitality than the native plants. To take one or two instances of this peculiar method of spreading, the *Rudbeckia hirta* is said to have come into New England with hay seed from the West, and is evidently increasing, while in New Brunswick I have heard it claimed that the white-weed (*Leucanthemum vulgare*) has spread with other Yankee notions from the neighboring states. It has certainly proved a successful invader and has taken possession of half the cultivated country.

I cannot refrain from inserting here a note from Sir J. E. Tennent's "Ceylon" in relation to the curious seeds of *Spinifex squarosus*, the "water-pink" as it is sometimes called by Europeans.

"The seeds of this plant are contained in a circular head, composed of a series of spine-like divisions, which radiate from the stalk in all directions, making the diameter of the whole about eight or nine inches. When the seeds are mature, and ready for dispersion, these heads become detached from the plant, and are carried by the wind with great velocity along the sands, over the surface of which they are impelled by their elastic spines. One of these balls may be followed by the eye for miles as it hurries along the level shore, dropping its seeds as it rolls, which speedily germinate and strike root where they fall. The globular heads are so buoyant as to float lightly on the water, and the uppermost spines acting as sails, they are thus carried across narrow estuaries to continue the process of embanking on newly formed sand-bars. Such an organization irresistibly suggests the wonderful means ordained by Providence to spread this valuable plant along the barren beach to which no seed-devouring bird ever resorts; and even the unobservant natives, struck by its singular utility in resisting the encroachments of the sea, have recorded their admiration by conferring on it the name of Maha-Rawana-raewula, 'the great beard of Rawana or Rama.'"

As to the duration of seeds there are many conflicting accounts. All are familiar with the old story of the grain found with Egyptian mummies, which vegetated after its disinterment and gave rise to a peculiar kind of wheat. This was a pleasant tale with which to point a moral, but it is now discredited by those most familiar with the facts. Still, it holds its place in many popular books, and shows the ease with which incorrect statements may

gain credence, and with what difficulty they are refuted when once proclaimed. That some seeds do live for a long time cannot be doubted, but no such extreme limit is authenticated as that cited for the mummy wheat. There are too many opportunities for error and even fraud, where a story is received at second hand from the Arabs. The largest of the accepted statements look a mite apocryphal. With most seeds the principle of life is evanescent, and it is with extreme difficulty that many can be transported from one climate or country to another. Even those that preserve their appearance unchanged and remain suitable for food, are often found to have lost their power of germination. It is claimed, and probably with truth, that when the thorn-apple (*Datura stramonium*) springs up in a place where it has not been seen before for many years, or even during the life-time of the observer, that the seeds have been lying dormant in the soil until some favorable condition has caused them to vegetate. So also when weeds, hitherto unknown in the vicinity, spring up along the embankments of a newly opened railway, or upon the ruins of extensive conflagrations. But these are only exceptions to the general rule, that to insure the vegetation of seed, it is necessary to plant it within a limited space of time, and that the preservation of it indefinitely is hazardous. The conditions necessary for the retention of vitality are not as yet certainly known, but it is thought that a particular amount of dryness, together with the exclusion of light and air, are essentials to success.

The total amount of seed produced by some plants is very remarkable. Linnæus says that a single stem of tobacco yields forty thousand seeds, and we all know how well provided with them are our commonest plants. It follows, then, that while, may be, a portion remain as I have said, dormant for a certain time, yet many are destroyed by unfavorable conditions, or as food for animals and man. We are thus reminded of the suggestive lines of Holmes:

> "Look at the wasted seeds that Autumn scatters,
> The myriad germs that Nature shapes and shatters."

I have already spoken of the dissemination of seeds and the means by which it is effected. We will now examine with the microscope the seeds themselves. Those of Stellaria are always pretty objects, as are likewise those of the clove pink (*Dianthus caryophyllus*) and other genera of Caryophyllaceæ. The seed of

Collomia linearis is a very remarkable object. It is, in its normal condition, dry and hard, but when moistened and placed beneath the microscope, we are astonished to find it covered with myriads of little threads, which project into the water, and keep it in constant motion. These are spiral fibres, which when dry, remain closely attached to the surface of the seed. The seed of Geranium appears as if enclosed in a net, that of Hypericum is crested upon one side, and is aptly compared by Lindley to an ancient helmet, while the tiny black fruit of Polygala is covered with white hairs, and is provided with a curious appendage called a caruncle. This seems to be composed of light cellular tissue, which, when magnified, owing to its beautiful whiteness and the distinct demarcation of its cells, resembles frost-work ; or to the chemist, suggests more strikingly the appearance of a glass rod which has been heated, and suddenly cooled by immersion in water. Corydalis is furnished with an aril, or accessory appendage, as is also the Euonymus, and many other plants. The aril in Euonymus, is red, and is one cause of the extreme beauty of this plant in autumn, when its colored pods expand and reveal the deeper tinted coating of the seed within.

With the beautiful colors often assumed by seeds, all are of course acquainted who in childhood have arrayed the gayly tinted beans in military order. Nearly all the primary colors are brought into play to ornament the different seeds, while some, more regal in their fancies, are bedecked with bronze and gold. The mention of beans, suggests the use of seed to man, the Gramineæ and Leguminosæ furnishing a very large proportion of our food. Then, too, when we think that all our fruits have a direct relation to the seeds, we must feel how absolutely dependent we are upon these unborn plantlets for our sustenance and comfort.

Yet there are many seeds that are not edible, and others that are extremely noxious. The most deadly substance known, perhaps, is prepared from the seed of *Strychnos nux-vomica*. From this fact alone, and the knowledge that even here destructive seeds surround us, we learn that the study we have been engaged in, is not a profitless occupation. It teaches us, not only the hidden beauties that encompass us, but how to discriminate between the hurtful and the beneficial fruits — the worthless and the advantageous.

THE LONDON FOG.

BY J. VILA BLAKE.

Apropos of the dense fog which recently enveloped the English metropolis, the news and some details of which have crept from the English press into our own, the following extract from a private letter describing this rather rare occurrence as seen (and felt also) by American eyes, will probably be read with interest, especially as we have here no similar phenomenon which can be compared with a genuine London fog:—

"One of the many things that I enjoyed in London was a London fog—only think of it! It was a great piece of good fortune; for, although at this season of the year it is always foggy, yet one of these very dense ones is not of very frequent occurrence. Really, it was a thing well worth the seeing, and for nothing, too, without a fee. It had been very foggy for about twenty-four hours, though not so much so but that we could get about well enough. At six, after tea, H. proposed that we should go to hear Trovatore; so we went, and such a sight I never saw as that stage. It was really ludicrous, trying to peer through the smoky mist to see what was going on. Scenes, dresses, sparkling jewelry, all were thrown away; nothing could be seen, and the atmosphere, in addition, was so *irritating to the eyes*, that although there was nothing in the opera to move one, the audience seemed to be perpetually in tears. On coming out we saw at once what had been going on in the two or three hours since leaving home. The fog lay thick and dense around us; the link-boys were out in all their glory, dashing wildly about among the bewildered crowds, with their 'Have a torch, sir?' 'Light you home, sir?' 'Better take me, sir!' Then darting frantically into the blackness they were lost, only to reappear again, thrusting their blazing firebrands so near your clothing that it really seemed frightful. Drivers were offered enormous sums by terrified people to take them home,—offers refused with frightful oaths; helpless women clung to railings for safety; now and then a solitary omnibus came along, each horse led by a link-boy with his flaming torch; men knocked against each other, and *we* clung tightly to each other's arms and strove to keep each other in sight. On crossing the street opposite Charing-Cross Hotel, which is there very wide and is the point of meeting of five different ways, we were only guided by the sound of the horses' hoofs, and even then it was very hard to judge of the direction of the sound. We walked in faith, com-

pletely, if never before. Milton speaks of the 'palpable obscure.' He must have had a London fog in his mind, when he described the flight of the cursed angel through the misty, murky air. Finally we reached home in safety, fully appreciating what we had been through. The next day the papers were full of it, and, strange to say, reported but few accidents. Some women actually spent the whole night in the streets, afraid to stir, and no policeman, or watch, could be bribed to guide them home. H. passed quite a number clinging to the rails of Charing-Cross Hotel, and an hour afterwards, on his return, they were still there, and there, the paper said, the morning found them."

That the foregoing description of this remarkable feature of the meteorology of London is not at all exaggerated, appears from the account of many of the more noteworthy fogs recorded in Howard's "Climate of London." That authority mentions fogs, in the forenoon, of such density that drivers could not see their horses' heads; and in the evening of such opacity that "the most brilliant gaslight could scarcely penetrate the gloom."

Describing a very thick fog occurring in November, 1828, and remarking upon its physiological effects, the author says:—

"It began to thicken very much about half-past twelve o'clock, from which time, till nearly two, the effect was most distressing, making the eyes smart, and almost suffocating those who were in the street, particularly asthmatic persons. . . . . In the great thoroughfares, the hallooing of coachmen and drivers to avoid each other, seemingly issuing from the opaque mass in which they were enveloped, was calculated to awaken all the caution of riders, as well as of pedestrians who had to cross the streets."

These vaporous visitations are commonly very limited in extent. Often while the city is in more than midnight obscurity, and men and horses are groping their invisible way, step by step, only four or five miles from town the sky is unclouded and the sun shining brilliantly. The authority before referred to, records:—

"The fog of Wednesday (Dec. 31, 1817) seems to have been confined to the metropolis and the immediate vicinity. No further northward than the back of Euston Square, the weather was clear and even bright. A gentleman, who came to London from Enfield, saw no fog till he approached London. Southward of London, it extended as far as Clapham, and it was rather worse in some of the environs than in the metropolis itself. Upon an average, ten feet was the distance at which objects became invisible, out of doors. Within doors it was impossible to read without a candle."

But while this fog was thus limited at London, there was a sim-

ilar one the same day in Dublin which was probably a part of the same meteorological phenomenon, as appears from the following paragraph quoted from a Dublin journal of Jan. 1, 1818:—

"The oldest person living has no recollection of a fog so thick as the one which enveloped this city last evening, between the hours of six and nine. It was more dense in some streets than in others, and where this was the case it was impossible to pass with convenience without the aid of opened lanterns."

The occurrence of these fogs in frosty weather, is often the occasion of rare and exquisite displays of wintry beauties on shrubs, trees and buildings. Howard writes:—

"1814. January 4th. The mists, which have again prevailed for several days, and which have rendered travelling dangerous, are probably referable to stratus clouds. The air has been, in effect, loaded with particles of freezing water, such as in a higher region would have produced snow. These attached themselves to all objects, crystallizing in the most regular and beautiful manner. A blade of grass was thus converted into a pretty thick stalagmite; some of the shrubs, covered with spreading tufts of crystals, looked as if they were in blossom; while others, more firmly incrusted, might have passed for gigantic specimens of white coral. The leaves of evergreens had a transparent varnish of ice with an elegant white fringe. Lofty trees, viewed against the blue sky in the sunshine, appeared in striking magnificence; the whole face of nature, in short, was exquisitely dressed out in frost-work."

As an example of a similar beautiful phenomenon in a distant latitude and very different climate, I extract the following from Knox's "Overland through Asia," just published:—

"Our road for seventy versts lay along the bank of the Angara. A thick fog filled the valley and seemed to hug close to the river. In the morning, every part of our sleigh, except at the points of friction, was white with frost. Each little fibre projecting from our cover of canvas and matting became a miniature stalactite, and the head of every nail, bolt, and screw, buried itself beneath a mass like oxydized silver. Everything had seized upon and congealed some of the moisture floating in the atmosphere. Our horses were of the color, or no color, of rabbits in January; it was only by brushing away the frost that the natural tint of their hair could be discovered, and sometimes there was a great deal of frost adhering to them.

During my stay at Irkutsk I noticed the prevalence of this fog or frost cloud. It usually formed during the night, and was thickest near the river. In the morning it enveloped the whole city,

but when the sun was an hour or two in the heavens the mist began to melt away. It remained longest over the river, and I was occasionally in a thick cloud on the bank of the Angara when the atmosphere a hundred yards away was perfectly clear. The moisture congealed on every stationary object. Houses and fences were cased in ice, its thickness varying with the condition of the weather. Trees and bushes became masses of crystals, and glistened in the sunlight as if formed of diamonds. I could never wholly rid myself of the impression that some of the trees were fountains caught and frozen when in full action. The frost played curious tricks of artistic skill, and its delineations were sometimes marvels of beauty. Any one who has visited St. Petersburg in winter remembers the effect of a fog from the Gulf of Finland after a period of severe cold. The red granite columns of St. Isaac's church are apparently transformed into spotless marble by the congelation of moisture on their surface. In the same manner I have seen a gray wall at Irkutsk changed in a night and morning to a dazzling whiteness. The crystalline formation of the frost had all the varieties of the kaleidoscope without its colors."

Lest some Yankee, whose study of Latin has not robbed him of his birth-right utilitarianism, should ask of the London fog, *cui bono?*, I will quote in conclusion, a pleasing little speculation of Howard, which may serve as an answer in some sort. Thomas Hughes remarks that he considers the power and glory of England to be due in no small degree to the prominence and virtues of the family of "Brown." Our meteorologist seeks to explain one way in which those same "Browns" are developed, and traces the connection between that illustrious family and a London fog (and other forms of moisture) thus:—

"Since man includes in his composition the elements of the inferior natures, and among these the *vegetable*, it is probable that the very growth of our bodies may so depend on moisture, that it could not go on in air of a certain degree of dryness. It is at least plain, that mankind is of a larger growth in rainy countries (whether these be warm or cold) than in those that are subject for a great part of the year to the dry extreme. In like manner, and from like causes, in part, we see that the inhabitants of crowded cities, and manufacturing towns, arrive at a less growth than those in even worse circumstances, as to diet and clothing, in the country; the latter being so much more exposed, in childhood and during adolescence, to the weather."

THE GAME FALCONS OF NEW ENGLAND.

BY WILLIAM WOOD, M.D.

In the April number of the NATURALIST, for 1870, I published an article on Falconry. I now propose to describe, in this and some future numbers, all the falcons found in New England, that were formerly used, or can be trained to capture game, with an account of their habits, manner of nesting, and their eggs. While there are nine of the subgenus Falco found within the limits of North America, only three are found in New England, if I except the gerfalcon, which, if found at all, must be wholly accidental. In this genus, we find birds of smaller size and strength, yet possessing all the courage and swiftness of the eagles. These were the birds used in falconry, and called noble because of the high prerogative of those who followed this amusement. In these, the bill is short, sharp, and curved from the base; the nostrils are circular with a central tubercle. They are easily distinguished from all other hawks by a prominent tooth in the upper mandible, shaped like the letter V, and a notch in the lower one to receive it. This genus is considered by naturalists as "the typical, or most highly or completely organized of rapacious birds."

I will first describe the *Falco peregrinus* Wilson. This is very commonly called the Peregrine falcon, and is inferior to none of its genus in beauty, courage and rapacity. There seems to be some diversity of opinion as to the identity of this and the European species. Bonaparte, DeKay and others, consider them distinct, while Nuttall, Pennant, Audubon and others, believe them identical. Audubon remarks that "once when nearing the coast of England, being then about one hundred and fifty miles distant from it, in the month of July, I obtained a pair of these birds which had come on board of our vessel and had been shot down. I examined them with care, and found no difference between them and those which I shot in America." This is the bird that was so highly prized and mostly used in England for falconry, and among the many hundreds owned by the Grand Khan, once Emperor of Tartary and China, the Peregrine falcon was considered second to none, except the gerfalcon. They are much more common now

than formerly. Audubon remarks "that within his remembrance it was a very scarce species in America, and if he shot one or two in the course of a winter, he considered himself fortunate; whereas, of late years, he has shot as many in a day, and perhaps a dozen in the winter." This bird is sometimes called the Great-footed hawk, on account of the large size of its feet, which are enormous considering the size of the bird. Those not aware of this fact would think it a deformity. On the seashore it is known by the name of the Duck hawk, from its habit of capturing and feeding upon ducks, and the stories relating to its exploits, as narrated by the hunters, are too marvellous to be entitled to credit. It is said that this bird will follow after the gunners, knowing that the report of their guns will start the ducks, and thus afford an opportunity for capturing them, and if not successful, will sometimes seize the game shot by the sportsmen before they can reach it, and fly off with it; but as "it is a poor rule that does not work both ways," the hunter as often secures water-fowls captured by the hawks, before they can carry them away or devour them.

Until quite recently, it has been supposed that the Rocky Mountains were the extreme western limit of this falcon, and that its congener, the *Falco nigriceps*, was its representative in the western portion of this continent, but more recent investigations have given this bird a much larger range. In a letter from Professor S. F. Baird, of Dec. 24th, 1870, he says, "the duck hawk, by our latest researches, is found from Labrador around the entire northern coast to Behring's Straits, and Alaska, of precisely the same general nature as the bird of eastern United States. The western *Falco nigriceps* is, I am now satisfied, simply a smaller race of the duck hawk, and occurs from Puget Sound southward to Chili."

This falcon is bold and powerful, and not excelled by any bird in rapidity of flight. One belonging to Henry II. of France, which flew after a little bustard at Fontainebleau was captured at Malta the next morning and recognized by the ring which it wore; consequently it must have flown one thousand three hundred and fifty miles. One sent to the Duke of Lerma returned in sixteen hours from Andalusia to the Island of Teneriffe, a distance of seven hundred and fifty miles. In the British Zoology, there is an account of one that escaped from its master, in the shire of Angus, a county on the east side of Scotland, with two heavy bells at-

tached to each foot, on the 24th of September, 1772, and was killed on the morning of the 26th near Mostyn, Flintshire.

They live to a great age. In 1793, one was caught at the Cape of Good Hope, and brought to England with a golden collar about its neck, with the date 1610, and an inscription indicating that it belonged to James I. of England. This falcon must have been at least one hundred and eighty-three years old, yet it still appeared lively, but its eyes were dim, and the feathers about the collar were changed to white.

It seldom is seen sailing like most other hawks, but either ascends with a broad spiral circle till it gains a suitable height to select its prey, or perches upon a tree that overlooks some swampy ground where snipe and rail abound, and darts down upon its game with such swiftness that destruction is inevitable. If the bird is too heavy to fly with, it is forced to the ground, otherwise it is carried to the woods and devoured at leisure. In the vicinity of their breeding places they are a terror to the poultry as well as a dread to the farmer, for there they usually hunt in pairs, one following directly after the other, and if the first one misses the game, the other is sure to pick it up; there is no escaping the two. This is the universal testimony of all the farmers living in the vicinity of the cliffs where they breed. One of my collectors went over one hundred miles to get a nest of their eggs, from only hearing a farmer in the vicinity of a cliff describe their manner of hunting; knowing from this circumstance alone, that it must be the duck hawk.

It is stated "that it preys chiefly upon sea-ducks, and therefore is, for the most part, met with on the coast, — is rarely found inland, and its migrations and wanderings are influenced by the flight of its favorite game." This was not the experience of Wilson and Ord along the coast of New Jersey. "To behold this hero, the terror of the wild fowl and the wonder of the sportsman, was the chief object of our wishes. Day after day did we traverse the salt marshes, and explore the ponds and estuaries, which the web-footed tribes frequent in immense multitudes, in the hope of obtaining the imperial depredator; even all the gunners of the district were summoned to our aid, with the assurance of a great reward if they procured him, but without success." Some time after this, Mr. Wilson received a specimen from Egg Harbor. Most of the observations made on this continent relative to the

duck hawk and its habits, have been made along the coast of Labrador and Newfoundland, where the shores and islands abound with rugged cliffs, affording them the very best place to be found anywhere on our Atlantic coast for nidification. This, in connection with an abundance of sea fowls, makes it the favorite resort of this bird; yet, it is nevertheless a fact, that all along our mountainous ranges, whether inland or not, wherever precipitous cliffs are found, they do live and breed, probably resorting to the seashore in the winter, as game is more abundant there. It is said that they are not uncommon in Kansas, and are found in Iowa. I do not find the duck hawk included in Mr. J. A. Allen's list of the birds of western Iowa, yet Mr. L. E. Ricksecker writes me that "he has a fine specimen of the eggs, collected in Iowa, March 21st, 1868."

Manner of nesting. — Ord says, that the duck hawk breeds on trees in the gloomy cedar swamps which are almost inaccessible to the foot of man. This is probably only his belief, for I am unable to learn from his writings that he ever saw a nest, and furthermore, he acknowledges that Wilson and himself faithfully, yet unsuccessfully searched the cedar swamps of New Jersey where they were supposed to breed. Neither Audubon, nor Nuttall ever saw a nest within the limits of the United States, and the former had some doubts as to its rearing young within the above named limits, yet says, "I think they breed in the United States, having shot a specimen in the month of August, near the falls of Niagara."

About the year of 1850, I was aware that a pair of these hawks nested on Talcott Mountain, about ten miles west of Hartford, from the fact that they frequented this place in the spring, summer, and fall months, and I had also seen an adult and young that were shot there in June. Not being aware at that time, that the nest had ever been found within the limits of the United States, I determined, if possible, to settle the question of their nesting, and the manner of their nesting, in Connecticut. For this purpose, I visited the mountain several times, and offered a liberal reward to those living in the vicinity for finding the nest, but it was not until 1861 that my efforts were crowned with success. Four young were taken from the nest alive, and the parent bird shot. This, as I stated in a series of articles which I was then publishing on the "Rapacious Birds of Connecticut," was about the first of June, but on getting the exact date from the captor, I find it was

May 25th that they were taken from a cliff on Talcott mountain, about twenty feet from the summit. It was with inexpressible delight that I viewed these birds, for I then supposed that I was the first to settle the mooted question, and in the article above referred to, I stated that this settles beyond dispute three points; first, that they breed on cliffs; second, that they breed in Connecticut; and third, that they nest very early. These young birds were evidently from four to six weeks old when captured, and allowing three weeks for incubation, it must bring the time of nesting the latter part of March. This was the first nest of the duck hawk ever taken in New England so far as is known to naturalists. The young were kept alive, and two of them were given to Professor S. F. Baird in the fall of 1862, when on a visit to E. W. Hill, and were kept alive at the Smithsonian Institution until the spring of 1863. A few years after this, my attention was called to a note in Dr. Brewer's North American Oölogy, part 1st, page 9, in which it appears that Prof. S. S. Haldeman had found the nest and captured the young on a high and almost vertical cliff on the banks of the Susquehanna; the account of which was published in the "Proceedings of the Academy of Natural Sciences," vol. I, page 54, 1841. Prof. Haldeman says, in that article, "it is asserted in the works on American ornithology that the *Falco peregrinus* builds its nest on trees, and not in the clefts of rock as in Europe. So far as my observations have gone this remark is incorrect, inasmuch as they build in the cliffs which border the Susquehanna. This species remains in Pennsylvania ten or twelve months in the year."

It is now universally admitted that duck hawks nest on cliffs and never on trees, and that they select places difficult to get at and often inaccessible, which is, no doubt, the reason that the eggs have been so seldom found. Says Audubon, in speaking of the nests found on the high and rocky shores of Labrador and Newfoundland, "they were placed on the shelves of rocks, a few feet from the top, and were flat and rudely constructed of sticks and moss." The nest on Talcott Mountain was of the same construction. The nests found by Mr Bennett in Massachusetts and Vermont were entirely destitute of sticks and moss. Mr. B. in describing to me the several nests which he has been fortunate enough to find, says, "they are built a little below the summit of the ledge, on a projection of rocks, which in one instance was not more than one foot in width, without sticks, grass, moss, or the

least vestige of a nest except a slight hollow in the earth, there being barely soil enough to keep the eggs from rolling out. In one instance where there was a little grass on the projection, it was all removed, and nothing but the bare earth left for the nest."

Mr. J. A. Allen, in his "Notes on some of the Rarer Birds of Mass.," gives Mr. Bennett the credit of being the first to find the eggs (April 19, 1864), so far as is known to naturalists, within the limits of the United States. I have received letters from two different sources, claiming to have found the eggs in Pennsylvania and Maryland some years prior to that date. If so, oölogists would not have been any the wiser had it not been for Mr. Bennett's persevering labors. So far as I am able to find any published account of it, Mr. B. is entitled to priority.

It would seem that the duck hawk is not a very pugnacious bird, as other birds are often found nesting quite near it. Says Audubon, "in several instances we found these falcons breeding on the same ledge with Cormorants (*Phalacrocorax carbo*)." Says Mr. G. A. Boardman, "the cliffs on which the duck hawk breeds are very high, and often when above you cannot tell where to go over, as you cannot see the nest from above or below unless the bird flies off. It is so with the ravens. They breed within a few rods of one another in one place." They become very much attached to their nests, and will occupy them as long as they live if not repeatedly robbed of their eggs and disturbed. If one of the pair is shot the surviving one will secure a mate and return to the same nest. In the north of Scotland they breed on the precipitous cliffs of that mountainous region, and some of the eyries have been known traditionally, as far back as the annals of the district extend. Mr. Bennett informs me that a farmer residing in Vermont, under a precipitous cliff, told him that a pair of eagles (duck hawks), had occupied the same nest on the ledge ever since he owned the farm, thirty-seven years, and how much longer he could not tell. Mr. Bennett, with great effort, secured for me from that nest a set of four of the handsomest and most uniformly marked eggs of the duck hawk that I have ever seen. From the same source I learn that this falcon defends it eyrie several weeks prior to occupying it, with as much and even more tenacity than during incubation. This peculiarity is not exclusively confined to this bird, for I have observed the same in some others of our rapacious birds while building their nests. They nest very early and are much

more cleanly in their habits than most birds of prey. Audubon says, "their season of breeding is so very early that it might be said to be in the winter." This needs a little explanation. At the time this was written the only eggs of the duck hawk known to oölogists on this continent were found north of the limits of the United States, where the season is so much later than in our latitude, that snow is frequently on the ground when the eggs are collected. One of my collectors in that locality writes, "I got a nest last spring as early as the first of April, when the snow was a foot deep." This certainly would appear like winter to one accustomed to see the frost out of the ground and the roads settled, as it often is here at that time. The usual time of nesting is from the last of March to the middle of April; sometimes earlier, and sometimes later, but no more irregular as to time than most of our rapacious birds. They will nest two and possibly three times during the season if the eggs are taken as often, as appears from the observations of Mr. Bennett.

If the arbitrary law of James I. of England, relative to robbing the peregrine falcon's nest ("the taking of the eggs, even on a person's own ground, was punished with imprisonment for a year and a day, together with a fine at the king's pleasure"), had been in force in the United States, until quite recently, there could not have been a much less number of their eggs found in our oölogical cabinets that were obtained within our own territory.

The common number of eggs found in a nest is three or four. Audubon once found five. The size and markings vary considerably according to the observations of different writers upon the subject. The first set obtained by Mr. Bennett were quite different in size and markings. Audubon remarks, "the eggs vary considerably in size and markings, which I think is owing to a difference of age in the females; the eggs of the young bird being smaller." This certainly cannot account for the unusual difference in the set obtained by Mr. Bennett, for they were all taken out of the nest at one time, and must have been laid by one bird. Mr. G. A. Boardman writes that "the duck hawk's eggs I find vary much in size and color, the last nest I got from the cliffs at Grand Menan were very oddly marked; one looks very much like the fish hawk's, only differing in size; in another, half the egg is white, with brown blotches on each end." I think the set of Mr. Bennett and that of Mr. Boardman are exceptional cases, as before

me are thirteen eggs of the duck hawk obtained in very different localities, viz: Massachusetts, Vermont, Labrador and Alaska, which are quite irregularly marked, yet as uniform in size and markings as any of the blotched eggs of our rapacious birds. In my collection are fifty-seven eggs of the Red-shouldered hawk (*Buteo lineatus*), and the variations both in size and markings are fully as great and rather more so than those of the duck hawks referred to above. The measurement of one egg from each set will be sufficient (as those belonging to the same set in my own collection are very uniform in size) to show that the difference in size is not very great, although they were collected in widely separate localities.

Massachusetts,—Size of egg, long diameter,	2.15	in.;	short	diameter,	1.80	in.
Vermont,	"	"	"	"	"	2.08	"	"	"	1.75 "
Labrador,	"	"	"	"	"	2.10	"	"	"	1.68 "
Alaska,	"	"	"	"	"	2.10	"	"	"	1.70 "

The eggs are oblong—larger at one end than the other. The egg from Labrador is quite pointed; those from Massachusetts and Alaska are less so, while those from Vermont are but slightly smaller at one end than the other. The ground color is light reddish brown, mottled with darker shades of the same color in irregular blotches, most abundant at one end, usually the larger end, but occasionally the markings are more delicate and quite evenly distributed. There is now and then an egg in which the ground color is dirty white.

Length of bird, 16–20 inches; alar extent, 36–42 inches; compact and firmly built; neck short, feet remarkably large, upper mandible with a tooth-like process, and a corresponding notch in lower. Adult, head and hind neck dark brown, upper parts bluish gray with darker bands, lower part yellowish white with breast and sides transversely barred with black, cheeks with a patch of black; tail brownish black with eight transverse bars of pale cinereous; legs and toes yellow, bill light blue, eyes hazel. Younger specimens, entire upper parts brownish black, space on cheek black, with long longitudinal stripes of brownish black on the under parts, instead of transverse as in the adult; legs bluish lead color.

A HEARTH OF THE POLISHED STONE AGE.*

On the summit of a steep hill between the valley of the Bas Roches and that of the Dheune, overlooking the immense plain of the Saône, and commanding a view of the Jura, the Alps, and the mountains of the Maconnais and the Morvan, and surrounded by numerous other camps, is the camp of Chassey, which occupies an area of about eight hundred yards in length by a breadth varying from about one hundred to two hundred yards. So commanding and important a spot was not only taken possession of by the Romans for a *castellum*, and by the Gauls for an *oppidum*, but was also occupied in prehistoric times. Several collections of antiquities belonging to different periods have been formed upon the spot, but it was reserved for M. Perrault to make the interesting discovery which he has recorded in so simple yet so complete a manner in the pages now before us. A terrace, sheltered by rocks from the north and east winds and facing the morning sun, seemed to him well adapted for early habitations, while a depression in the ground in front proved, on examination, to contain the remains of a large hearth, or it might be termed kitchen, and here he instituted excavations.

Beneath a few inches of soil he found a bed rather more than two feet in thickness, made up of ashes, bones, and pottery, and containing numerous instruments of various kinds. The whole reposed on a platform of rough slabs of stone, blackened like the soil beneath them by the action of fire. Not a trace of metal was discovered, and in describing the objects found, M. Perrault divides them into (1) instruments of stone, (2) those of bone, and (3) pottery.

Exclusive of fragments, some one hundred and fifty stone instruments were found, consisting for the most part of hatchets, arrowheads, flakes, borers, scrapers, hammers, mealing stones and polishing stones. No less than eight perfect stone hatchets were found, as well as fourteen broken, and of those that were

* We copy from *Nature* of Jan. 19th the following interesting summary of a recent work by Ernest Perrault, entitled "Note sur un Foyer de l'Age de la Pierre polie decouvert au Camp de Chassey en Septembre, 1869." 1870. 4to. pp. 32, and 8 plates. London: Williams and Norgate.

uninjured two were still mounted in stag's horn sockets, similar to those with which the discoveries in the Swiss Lake dwellings have made us so well acquainted.

Only two are of flint, and one of fibrolite, the others being of chloromelanite, serpentine basalt, and diorite. They seem to have been formed from pebbles brought down by the Saône, and it is interesting to observe that the same process of manufacture was in use in this part of Burgundy as in Switzerland, the splitting of the pebbles into the required form having been partly effected by sawing. That some of the spare hours of those who frequented the hearth were employed in preparing their hatchets is proved by the large number of grinding or polishing stones, of which, counting fragments, upwards of sixty were present. M. Perrault regards one of the smallest of the cutting instruments, a little triangular celt, as a religious emblem, but it seems more probable that it was used as a hand-tool, like a chisel, of one of which the sharpened end was also found.

The arrowheads of flint, twenty-three in number, present a variety of forms, leaf-shaped, triangular, lozenge-shaped and tanged, the latter both with and without barbs. Their general aspect is such as might have been expected from the locality, most of the forms occurring also in Switzerland. There are, however, one or two shaped like small hatchets, with a broad, sharp base, formed by the original edge of the flake from which they were made, and rounded, or truncated at the other end. It is stated that this sharp edge was intended for insertion in the wood, but more probably it was the other end that was thus secured, and the arrows were, so to speak, chisel-pointed, like the flint-tipped arrows which survived in use, probably for fowling purposes, after metals became known to the ancient Egyptians. Similar arrowheads, if such they be, have been found in considerable numbers in Sweden, and a few in Denmark, as well as in some other parts of France. It seems by no means impossible that some of the sharp-based instruments from the Yorkshire Wolds may have served a similar purpose.

The mealing stones consist of a large block, usually of hard sandstone or porphyry, and a smaller stone as muller, and are of the same character as those still in use in Central Africa. They must have been gradually eaten together with the flour they produced, and no doubt tended to promote that wearing away of

the crown of the teeth, so common in ancient times. None of the grain has been found, but probably most of the cereals known to the old Swiss Lake dwellers were also known at Chassey.

The objects in bone and horn are almost identical with those from the earlier Swiss Lake dwellings, and consist of the sockets already mentioned, awls, chisels, etc. The pottery, which is extremely fragmentary, is much of the same character as the Swiss. It has been ornamented both by punctured dots and by a sort of pillar moulding, as well as by incised lines. In one instance there seems to have been an attempt to represent the outline of a boar by lines scratched in the clay when still moist. In another, the ornament consists of bands of triangles alternately cross-hatched and plain, a style more in accordance with the bronze age than with that of stone. Most of the pottery seems to have been adapted for suspension. The number of small ears or handles found exceeded two hundred. A few spindle-whorls and beads were also found, but the most curious objects are the spoons, exactly similar in form to those of wood in common use in our kitchens at the present day, but formed of clay. It is true that several wooden ladles and at least one earthenware spoon were found in the settlement of Robenhausen, but one can hardly repress a feeling of surprise at finding the spoon so fully and completely developed among a people apparently unacquainted with the use of metal, though it is true that they appear to have had the materials for porridge at their command.

In concluding this short notice of a valuable contribution to prehistoric archæology, a regret must be expressed that the animal remains discovered in the refuse heap have not, apparently, as yet been submitted to proper scientific examination, so as to determine the species, and which of them were domesticated, though some human remains from neighboring tumuli and interments are reported on by Dr. Pruner-Bey. The animals whose bones occurred are described as the ox (possibly domesticated), pig, stag, sheep, goat, and horse, which is rare. The bones are not always broken, and the vertebræ occasionally occurred in juxtaposition, as if meat at times had been extremely abundant. There is no mention of any remains or traces of dogs, and this condition of the bones seems to afford an argument in favor of their absence, which, if established, would be a remarkable fact. Some teeth of reindeer are mentioned as having been found on the plateau, and

it would be of great interest to ascertain their relation to the other remains. Let us trust that ere long there may again be a season in France when a thought may fairly be bestowed on other camps and other earthworks than those on which attention is now so unfortunately concentrated.

BRISTLE-TAILS AND SPRING-TAILS.

BY A. S. PACKARD, JR., M.D.

THE Thysanura, as the Poduras and their allies, the Lepismas, are called, have been generally neglected by entomologists, and but few naturalists have paid special attention to them.* Of all those microscopists who have examined Podura scales as test objects, we wonder how many really know what a Podura is?

In preparing the following account I have been under constant indebtedness to the admirable and exhaustive papers of Sir John Lubbock, in the London Linnæan Transactions (vols. 23, 26 and 27). Entomologists will be glad to learn that he is shortly going to press with a volume on the Poduras, which, in distinction from the Lepismas, to which he restricts the term Thysanura, he calls Collembola, in allusion to the sucker-like tubercle situated on the under side of the body, which no other insects are known to possess.

The group of Bristle-tails, as we would dub the Lepismas in distinction from the Spring-tails, we will first consider. They are abundant in the Middle States under stones and leaves in forests, and northward are common in damp houses, while one beau-

* Nicolet, in the "Annales de la Societe Entomologique de France" (tome v, 1847), has given us the most comprehensive essay on the group, though Latreille had previously published an important essay, "De l'Organization Exterieure des Thysanoures" in the "Nouvelles Annales du Museum d'Histoire Naturelle Paris, 1832," which I have not seen. Gervais has also given a useful account of them in the third volume of "Apteres" of Roret's Suite a Buffon, published in 1844.

The Abbe Bourlet, Templeton, Westwood, and Haliday have published important papers on the Thysanura; and Meinert, a Danish naturalist, and Olfers, a German anatomist, have published important papers on the anatomy of the group. In this country Say and Fitch have described less than a dozen species, and the writer has described a new species of Campodea, while Humbert has described in a French scientific journal a species of Japyx (*J. Saussurii*) from Mexico.

tiful species that we have never noticed elsewhere, is our "cricket on the hearth," abounding in the chinks and crannies of the range of our house, and coming out like cockroaches, at night, shunning the light. Like the cockroaches, which they vaguely resemble in form, this species loves hot and dry localities, in distinction from the others which seek moisture as well as darkness. By some they are called "silver witches," and as they dart off, when disturbed, like a streak of light, their bodies being coated in a suit of shining mail, which the arrangement of the scales resembles, they have really a weird and ghostly look.

The *Lepisma saccharina* of Linnæus, if, as is probable, that is the name of our common species, is not uncommon in old damp houses, where it has the habits of the cockroach, eating cloths, tapestry, silken trimmings of furniture, and doing occasional damage to libraries by devouring the paste, and eating holes in the leaves and covers of books.

In general form Lepisma may be compared to the larva of Perla, a net-veined Neuropterous insect, and also to the narrow-bodied species of cockroaches, minus the wings. The body is long and narrow, covered with rather coarse scales, and ends in three many-jointed anal stylets, or bristles, which closely resemble the many-jointed antennæ, which are remarkably long and slender. The thermophilous species already alluded to may be described as perhaps the type of the genus, the *L. saccharina* being simpler in its structure. The body is narrow and flattened; the basal joints of the legs being broad, flat and almost triangular, like the same joints in the cockroaches. The legs consist of six joints, the tarsal joints being large and two in number, and bearing a pair of terminal curved claws. The three thoracic segments are of nearly equal size, and the eight abdominal segments are also of similar size. The tracheæ are well developed, and may be readily seen in the legs. The end of the rather long and weak abdomen is propped up by two or three pairs of bristles, which are simple, not jointed, but moving freely at their insertion; they thus take the place of legs, and remind one of the abdominal legs of the Myriapods; and we shall see in certain other genera (Machilis and Campodea) of the Bristle-tails that there are actually two-jointed bristles arranged in pairs along the abdomen. They may probably be directly compared with the abdominal legs of Myriapods. Further study, however, of the homologies of these peculiar appendages,

and especially a knowledge of the embryological development of Lepisma and Machilis, is needed before this interesting point can be definitely settled. The three many-jointed anal stylets may, however, be directly compared with the similar appendages of Perla and Ephemera. The mode of insertion of the antennæ of this family is much like that of the Myriapods, the front of the head being flattened, and concealing the base of the antennæ, as in the Centipedes and Pauropus. Indeed the head of any Thysanurous insect seen from above, bears a general resemblance in some of its features to that of the Centipede and its allies. So in a less degree does the head of the larvæ of certain Neuroptera and Coleoptera. The eyes are compound, the single facets forming a sort of heap. The clypeus and labrum, or upper lip, is, in all the Thysanura, carried far down on the under side of the head, the clypeus being almost obsolete in the Poduridæ, this being one of the most essential characters of that family. Indeed, it is somewhat singular that these and other important characteristics of this group have been almost entirely passed over by authors, who have consequently separated these insects from other groups on what appear to the writer as comparatively slight and inconsiderable characters. The mouth-parts of the Lepismatidæ (especially the thermophilous Lepisma, which we now describe) are most readily compared with those of the larva of Perla.

Fig. 23.

The rather large, stout mandibles are concealed at their tips, under the upper lip, which moves freely up and down when the creature opens its mouth. The mandible is about one third as broad as long, armed with three sharp teeth on the outer edge, and with a broad cutting edge within, and still further within, a lot of straggling spinules. In all these particulars, the mandible of Lepisma is comparable with that of certain Coleoptera and Neuroptera. So also are the maxillæ and labium, though we are not aware that any one has indicated how close the homology is. The accompanying figure (23) of the maxilla of a beetle may serve as an example of the maxilla of the Coleoptera, Orthoptera, and Neuroptera. In these insects it consists invariably of three lobes, the outer being the palpus, the middle lobe the galea, and the innermost the lacinia; the latter undergoing the greatest modifications, forming a comb composed of spines and hairs varying greatly in relative size and length. How much the

palpi vary in these groups of insects is well known. The galea sometimes forms a palpus-like appendage. Now these three lobes may be easily distinguished in the maxilla of Lepisma. The palpus instead of being directed forward, as in the insects mentioned above (in the pupa of Ephemera the maxilla is much like that of Lepisma), is inserted nearer the base than usual and thrown off at right angles to the maxilla, so that it is stretched out like a leg, and in moving about the insect uses its maxillæ partly as supports for its head. They are very long and large, and five or six-jointed. The galea, or middle division, forms a simple lobe, while the lacinia has two large chitinous teeth on the inner edge, and internally four or five hairs arising from a thin edge.

The labium is much as in that of Perla, being broad and short, with a distinct median suture, indicating its former separation in embryonic life into a pair of appendages. The labial palpi are three-jointed; the joints being broad, and in life directed backwards instead of forwards, as in the higher insects.

There are four American species of the genus Lepisma in the Museum of the Peabody Academy, which contains, so far as we are aware, the only collection, small as it is, of Thysanura in the country. Besides the common *L. saccharina?* (Pl. 1, fig. 1) there are three undescribed species; one the heat-loving form, perhaps an imported species, found in a kitchen in Salem, and apparently allied to the *L. thermophila* Lucas, of houses in Brest, France; and two allied forms, one from Key West, and another from Polvon, Western Nicaragua, collected by Mr. McNiel. These three last species are beautifully ornamented with finely spinulated hairs arranged in tufts on the head; while the sides of the body, and edges of the basal joints of the legs are fringed with them.

The most complicated genus, and which stands at the head of the family, is Machilis (Pl. 1. figs. 8, 9), of which there are specimens in the Museum of the Peabody Academy, from Albany, N. Y., Virginia, and Oregon, indicating two species. They affect dry places, living under leaves and stones. They all have rounded, highly arched bodies, and large compound eyes, the pair being united together. The maxillary palpi are greatly developed; but the chief characteristics are the two-jointed stylets arranged in nine pairs along each side of the abdomen, reminding us of the abdominal legs of Myriapods. The body ends in three long bristles, as in Lepisma. The interesting genus Nicoletia stands at the bot-

tom of the group. It has the long, linear, scaleless body of Campodea, in the family below, but the head and its appendages are like Lepisma, the maxillary palpi being five-jointed, and the labial palpi four-jointed. The eyes are simple, arranged in a row of seven on each side of the head. The abdomen ends in three long and many-jointed stylets, and there are the usual "false branchial feet" along each side of the abdomen. There are two European species which occur in green houses. No species have yet been found in America.

The next family of Thysanura is the Campodeæ, comprising the two genera, Campodea, and Japyx. These insects are much smaller than the Lepismidæ, and in some respects are intermediate between that family and the Poduridæ (including the Smynthuridæ).

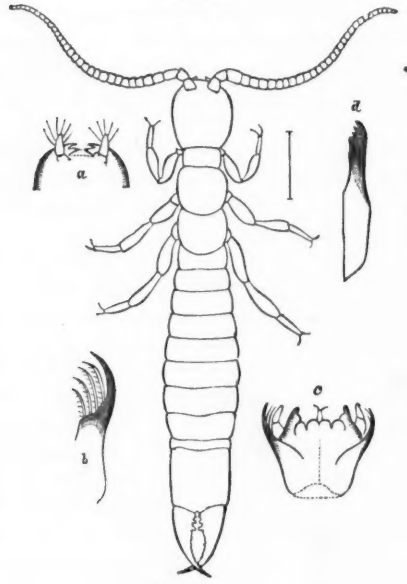
In this family the body is long and slender, and the segments much alike in size. There is a pair of spiracles on each thoracic ring. The mandibles are long and slender, ending in three or four teeth, and, with the other appendages of the mouth, are concealed within the head, "only the tips of the palpi (and of the maxillæ when these are opened) projecting a very little beyond the rounded entire margin of the epistoma," according to Haliday. The maxillæ are comb-shaped, due to the four slender, minutely ciliated spines placed within the outer tooth. The labium in Japyx is four-lobed and bears a small two-jointed palpus. The legs are five-jointed, the tarsi consisting of a single joint, ending in two large claws. The abdomen consists of ten segments, and in Campodea along each side is a series of minute, two-jointed appendages such as have been described in Machilis. These are wanting in Japyx. None of the species in this family have the body covered with scales.

The more complicated genus of the two is Japyx (Fig. 24, *Japyx solifugus* Hal.; *a*, the mouth from beneath, with the maxillæ open; *b*, maxilla; *d*, mandible; *c*, outline of front of head seen from beneath, with the labial palpi in position), which, as remarked by the late Mr. Haliday (who has published an elaborate essay on this genus in the Linnæan Transactions, vol. 24, 1864), resembles Forficula in the large forceps attached to its tail.

Campodea (*C. staphylinus* Westw., Fig. 25, enlarged; *a*, mandible; *b*, maxilla), otherwise closely related, has more rudimentary mouth-parts, and the abdomen ends in two many-jointed bristles.

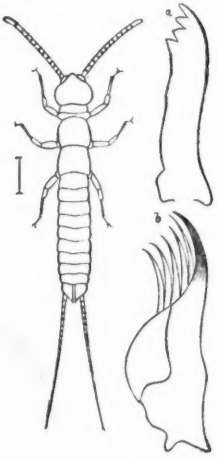
Our only American species of Campodea (*C. Americana* Pack.) lives under stones in damp places. It is yellowish, about a sixth of an inch in length, is very agile in its movements, and would easily be mistaken for a very young Lithobius. Haliday has remarked that this family bears much resemblance to the Neuropterous larva of Perla, as previously remarked by Gervais; and the many points of resemblance of this family and the Lepismidæ to the larval forms of those Neuroptera that are active in the pupa

Fig. 24.



Japyx.

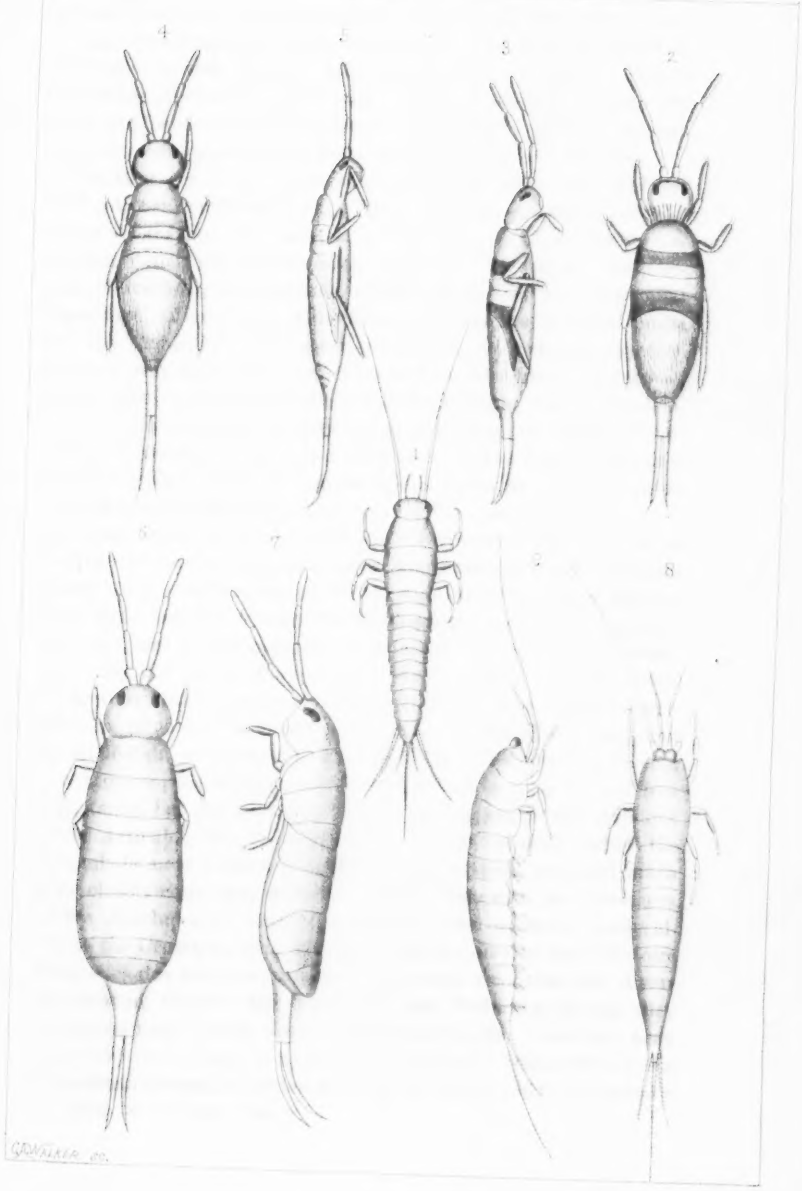
Fig. 25.



Campodea.

state (the Pseudo-neuroptera of Erichson and other authors) are very striking. Campodea resembles the earliest larval form of Chloëon, as figured by Sir John Lubbock, even to the single-jointed tarsus; and why these two Thysanurous families should be removed from the Neuroptera we are unable, at present, to understand, as to our mind they do not diverge from the Neuropterous type any more than the Mallophaga, or biting lice, do from the type of Hemiptera.

Haliday, remarking on the opinion of Linnæus and Schrank, who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referred Campodea to the old genus Podura, says with much truth, "it may be perhaps no unfair inference to draw, that the insect in question is in some measure intermediate between both." This is seen especially in the mouth-parts which are withdrawn into the head, and become very rudimentary, affording a gradual passage into the mouth-parts of the Poduridæ, which we now describe.

The next group, the Podurelles of Nicolet, and Collembola of Lubbock, are considered by the latter, who has studied them with far more care than any one else, as "less closely allied" to the Lepismidæ "than has hitherto been supposed." He says "the presence of tracheæ, the structure of the mouth, and the abdominal appendage, all indicate a wide distinction between the Lepismidæ and the Poduridæ. We must, indeed, in my opinion, separate them entirely from one another; and I would venture to propose for the group comprised in the old genus Podura, the term Collembola, as indicating the existence of a projection, or mammilla, enabling the creature to attach or glue itself to the body on which it stands." Then without expressing his views as to the position and affinities of the Lepismidæ, he remarks "as the upshot of all this, then, while the Collembola are clearly more nearly allied to the Insecta than to the Crustacea or Arachnida, we cannot, I think, regard them as Orthoptera or Neuroptera, or even as true insects. That is to say, the Coleoptera, Orthoptera, Neuroptera, Lepidoptera, etc., are in my opinion, more nearly allied to one another than they are to the Poduridæ or Smynthuridæ. On the other hand, we certainly cannot regard the Collembola as a group equivalent in value to the Insecta. If, then, we attempt to map out the Articulata, we must, I think, regard the Crustacea and Insecta as continents, the Myriapoda and Collembola as islands — of less importance, but still detached. Or, if we represent the divisions of the Articulata like the branching of a tree, we must picture the Collembola as a separate branch, though a small one, and much more closely connected with the Insecta, than with the Crustacea or the Arachnida." Lamarck regarded them as more nearly allied to the Crustacea than Insecta. Gervais, also, in the "Histoire Naturelles des Insectes: Apteres," indicates a considerable diversity existing between the Lepismidæ and Poduridæ, though they are placed next to each other. Somewhat similar views have been expressed by so high an authority as Professor Dana, who, in the "American Journal of Science" (vol. 37, Jan., 1864), proposed a

classification of insects (based on the principle of cephalization), and divided the Hexapodous insects into three groups: the first (Ptero-prosthenics, or Ctenopters) comprising the Hymenoptera, Diptera, Aphaniptera (Fleas), Lepidoptera, Homoptera, Trichoptera and Neuroptera; the second group (Ptero-metasthenics, or Elytropters) comprising the Coleoptera, Hemiptera and Orthoptera; while the Thysanura compose the third group. Lubbock has given us a convenient historical view of the opinions of different authors regarding the classification of these insects, which we find useful. Nicolet, the naturalist who, previous to Lubbock, has given us the most correct and complete account of the Thysanura, regarded them as an order, equivalent to the Coleoptera or Diptera, for example. In this he followed Latreille, who established the order in 1796. The Abbe Bourlet adopted the same view. On the other hand Burmeister placed the Thysanura as a separate tribe between the Mallophaga (Bird Lice) and Orthoptera, and Gerstaecker placed them among the Orthoptera. Fabricius and Blainville put them with the Neuroptera, and the writer, in his "Guide to the Study of Insects," and previously in 1863, ignorant of the views of the two last named authors, considered the Thysanura as degraded Neuroptera, and noticed their resemblance to the larvæ of Perla, Ephemera, and other Neuroptera, such as Rhaphidia and Panorpa, regarding them as standing "in the same relation to the rest of the Neuroptera [in the Linnæan sense], as the flea does to the rest of the Diptera, or the lice and Thrips to the higher Hemiptera."

After having studied the Thysanura enough to recognize the great difficulty of deciding as to their affinities and rank, the writer does not yet feel prepared to go so far as Dana and Lubbock, for reasons that will be suggested in the following brief account of the more general points in their structure, reserving for another occasion a final expression of his views as to their classification.

The Poduridæ, so well known by name, as affording the scales used by microscopists as test objects, are common under stones and wet chips, or in damp places, cellars, and about manure heaps. They need moisture, and consequently shade. They abound most in spring and autumn, laying their eggs at both seasons, though most commonly in the spring. During a mild December, such as just experienced, they may be found in abundance. Nearly a dozen species were found on the grounds of the Museum of the

Peabody Academy, affording ample material for study until nearly Christmas time, and again, late in February. About a hundred species are found in Europe, and nearly a quarter of that number I have, with the aid of my friend Mr. C. A. Walker, observed in this country, though paying little attention to them previous to last autumn.

The body of the Poduras is rather short and thick, most so in Smynthurus (Fig. 26), and becoming long and slender in Tomocerus and Isotoma. The segments are inclined to be of unequal size, the prothoracic ring sometimes becoming almost obsolete, and some of the abdominal rings are much smaller than others; while in Anura and Lipura, the lowest forms of the group, the segments are all much alike in size.

The head is, in form, much like that of certain larvæ of Neuroptera. The basal half of the head is marked off from the eye-bearing piece (epicranium) by a V-shaped suture (Fig. 28, head of Degeeria), and the insertion of the antennæ is removed far down the front, near the mouth, the clypeus being very short; this piece, so large and prominent in the higher insects, is not distinctly separated by suture from the surrounding parts of the head, thus affording one of the best distinctive characters of the Poduridæ. The eyes are situated on top of the head just behind the antennæ, and are simple, consisting of a group of from five to eight or ten united into a mass in Smynthurus, but separated in the Poduridæ (Fig. 41, *e*, eye of Anura). The antennæ are usually four-jointed, and vary in length in the different genera. The mouth-parts are very difficult to make out, but by soaking the insect in potash for twenty-four hours, thus rendering the body transparent, they can be satisfactorily observed. They are constructed on the same general type as the mouth-parts of the Neuroptera, Orthoptera, and Coleoptera, and except in being degraded, and with certain parts obsolete, they do not essentially differ. On observing the living Podura, the mouth seems a simple ring, with a minute labrum and groups of hairs and spinules, which the observer, partly by guess-work, can identify as jaws, and maxillæ, and labium. But in studying the parts rendered transparent, we can identify the different appendages. Fig. 29 shows the common *Tomocerus plumbeus* greatly enlarged, and as the mouth-parts of the whole group of Poduras are remarkably constant, a description of one genus will suffice for all. The labrum, or upper lip, is sepa-

rated by a deep suture from the clypeus, and is trapezoidal in form. The mandibles and maxillæ are long and slender, and buried in the head, with the tips capable of being extended out from the ring surrounding the mouth for a very short distance. The mandibles (*md*, Fig. 30) are like those of the Neuroptera, Orthoptera and Coleoptera, in their general form, the tip ending in from three to six teeth (three on one mandible and six on the other), while below (Fig. 41, *md*) is a rough, denticulated molar surface, where the food seized by the terminal teeth is triturated and prepared to be swallowed. Just behind the mandibles are the maxillæ, which are trilobate at the end, as in the three orders of insects above named. The outer lobe, or palpus, is a minute membranous tubercle ending in a hair (Fig. 31, *mp*), while the middle lobe, or galea, is nearly obsolete, though I think I have seen it in Smynthurus where it forms a lobe on the outside of the lacinia. The lacinia, or inner lobe (Fig. 31, *lc;* 32, the same enlarged), in Tomocerus consists of two bundles of spinules, one broad like a ruffle, and the other slender, pencil-like, ending in an inner row of spines, like the spinules on the lacinia of the Japyx and Campodea, and, more remotely, the laciniæ of the three orders of insects above referred to. There is also a horny, prominent, three-toothed portion (Fig. 31, *g*). These homologies have never been made before, but they seem natural, and suggested by a careful examination and comparison with the above-mentioned mandibulate insects.

The spring consists of a pair of three-jointed appendages, with the basal joint soldered together early in embryonic life, while the two other joints are free, forming a fork. It is longest in Smynthurus and Degeeria, and shortest in Achorutes (Fig. 36, *b*), where it forms a simple, forked tubercle; and is obsolete in Lipura, its place being indicated by an oval scar. The third joint varies in form, being hairy, serrate and knife-like in form, as in Tomocerus (Fig. 30, *a*), or minute, with a supplementary tooth, as in Achorutes (Fig. 36, *c*). This spring is in part homologous with the ovipositor of the higher insects, which originally consists of three pairs of tubercles, each pair arising apparently from the seventh, eighth, and ninth (the latter the penultimate) segments of the abdomen in the Hymenoptera. The spring of the Podura seems to be the homologue of the third pair of these tubercles, and is inserted on the penultimate segment. This comparison I have been able to make from a study of the embryology of Isotoma.

Another organ, and one which, so far as I am aware, has been overlooked by previous observers, I am disposed to consider as an ovipositor. In the genus Achorutes, it may be found in the segment just behind the spring-bearing segment, and situated on the median line of the body. It consists (Fig. 36) of two squarish valves, from between which project a pair of minute tubercles, or blades, with four rounded teeth on the under side. This pair of infinitesimal saws, remind one of the blades of the saw-fly, and I am at a loss what their use can be unless to cut and pierce so as to scoop out a place in which to deposit an egg. It is homologous in situation with the middle pair of blades which compose the ovipositor of higher insects, and if it should prove to be used by the creature in laying its eggs, we should then have with the spring, an additional point of resemblance to the Neuroptera and higher insects, and instead of this spring being an important differential character, separating the Thysanura from other insects, it binds them still closer, though still differing greatly in representing only a part of the ovipositor of the higher insects.

But all the Poduras differ from other insects in possessing a remarkable organ situated on the basal segment of the abdomen. It is a small tubercle, with chitinous walls, forming two valves from between which is forced out a fleshy sucker, or, as in Smynthurus, a pair of long tubes, which are capable of being darted out on each side of the body, enabling the insect to attach itself to smooth surfaces, and rest in an inverted position.

The eggs are laid few in number, either singly or several together, on the under side of stones, chips, or, as in the case of *Isotoma Walkerii* Pack., under the bark of trees. They are round, transparent. The development of the embryo of Isotoma in general accords with that of the Phryganeidæ and suggests the near relationship of the Thysanura to the Neuroptera.

Sir John Lubbock has given us an admirable account of the internal anatomy of these little creatures, his elaborate and patient dissections filling a great gap in our knowledge of their internal structure. The space at our disposal only permits us to speak briefly of the respiratory system. Lubbock found a simple system of tracheæ in Smynthurus which opens by "two spiracles in the head, opposite the insertion of the antennæ," *i. e.*, on the back of the head. (Von Olfers says, they open on the prothorax.) Nicolet and Olfers claim to have found tracheæ in several lower

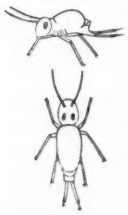
genera (Orchesella, Tomocerus, and Achorutes, and allied genera), but Lubbock was unable to detect them, and I may add that I have not found them either in living specimens, or those rendered transparent by potash, though careful search was made for them.

Having given a hasty sketch of the external aspect of the Poduras, I extract from Lubbock a synopsis of the families and genera for the convenience of the student, with the names of known American species, or indications of undescribed native forms.

SMYNTHURIDÆ.

Body globular or ovoid; thorax and abdomen forming one mass; head vertical or inclined; antennæ of four or eight segments. Eyes eight on each side, on the top of the head. Legs long and slender. Saltatory appendage with a supplementary segment.

Fig. 26.



Smynthurus.

Smynthurus Latreille. Antennæ four-jointed, bent at the insertion of the fourth, which is nearly as long as the other three, and appears to consist of many small segments. No conspicuous dorsal tubercles. (In this country Fitch has described five species: *S. arvalis*, *elegans*, *hortensis*, *Novæboracensis*, and *signifer*. Fig. 26 represents a species found in Maine.)

Dicyrtoma Bourlet. Antennæ eight-jointed, five before, three after the bend. Two dorsal tubercles on the abdomen.

Papirius Lubbock.* Antennæ four-jointed, without a well-marked elbow, and with a short terminal segment offering the appearance of being many-jointed.

PODURIDÆ.

This family comprises those species of the old genus Podura, in which the mouth has mandibles [also maxillæ and a labium], and the body is elongated, with a more or less developed saltatory appendage at the posterior extremity.

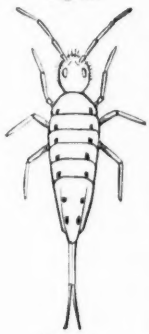
Orchesella Templeton. Segments of the body unequal in size,

*Lubbock considers that Papirius should be placed in a distinct family from Smynthurus, because it wants tracheæ. Their presence or absence scarcely seems to us to be a family character, as they are wanting in the Poduridæ, and are not essential to the life of these animals, while in other respects Papirius differs but slightly from Smynthurus.

more or less thickly clothed by clubbed hairs. Antennæ long, six-jointed. Eyes six in number on each side, arranged in the form of an S. (One or two beautiful species live about Salem.)

Degeeria Nicolet. Segments of the body unequal in size, more or less thickly clothed by clubbed hairs. Antennæ longer than the head and thorax, filiform, four-jointed. Eyes eight in number, on each side of the head. (Two species are figured on Pl. 1, figs. 2–5. Fig. 27 represents a species found in Salem, Mass., closely allied to the European *D. nivalis*. Fig. 28, head of a Degeeria, showing the parts of the head. Five species are already known in New England.)

Fig. 27.



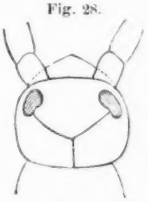
Degeeria.

Seira Lubbock. Body covered with scales. Antennæ four-jointed; terminal segment not ringed. Eyes on a dark patch. Thorax not projecting over the head. Abdominal segments unequal.

Templetonia Lubbock. Segments of the body subequal, clothed by clubbed hairs, and provided with scales. Antennæ longer than the head and thorax, five-jointed, with a small basal segment, and with the terminal portion ringed.

Isotoma Bourlet (*Desoria* Nicolet). Four anterior abdominal segments subequal, two posterior ones small; body clothed with simple hairs, and without scales. Antennæ four-jointed, longer than the head; segments subequal. Eyes seven in number on each side, arranged in the form of an S. (Three species are found in Massachusetts, one of which is figured on Pl. 1, figs. 6, 7.)

Fig. 28.



Head of Degeeria.

Tomocerus Nicolet. Abdominal segments unequal, with simple hairs and scales. Antennæ very long, four-jointed, the two terminal segments ringed. Eyes seven in number on each side. (The European *T. plumbea* Linn., *Podura plumbea* of authors, is one of our most common species. Fig. 29, greatly enlarged, copied from Templeton; fig. 30, side view, see also fig. 31, where the mouth-parts are greatly enlarged, the lettering being the same, *md*, mandibles; *mx*, maxillæ; *mp*, maxillary palpus; *lb*, labium; *lp*, labial palpus; *lc*, lacinia; *g*, portion ending in three teeth; *l*, lobe of labium; *sp*,

Fig. 30.

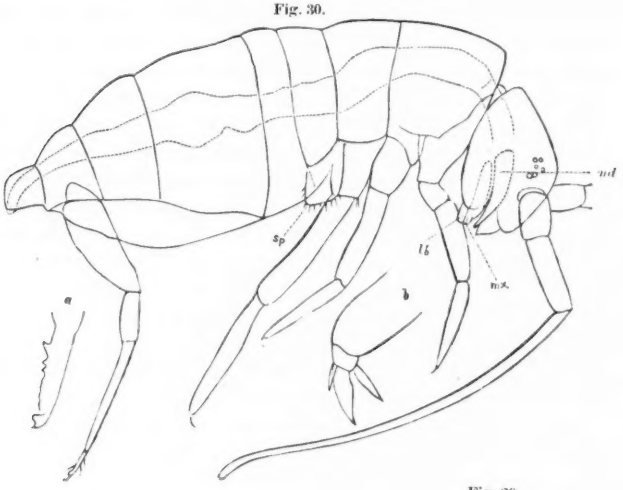


Fig. 29.

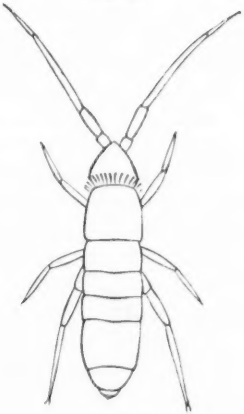


Fig. 33.

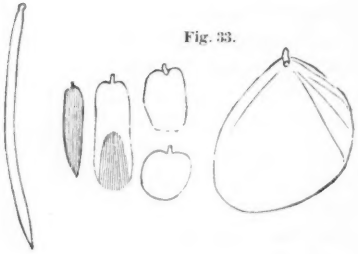


Fig. 31.

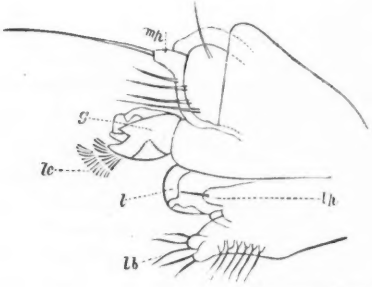
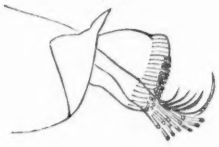


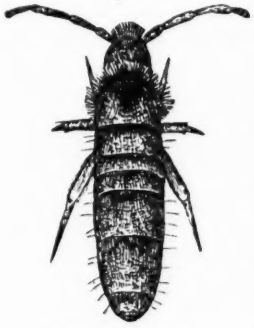
Fig. 32.



Tomocerus Plumbeus.

ventral sucking disc; the dotted lines passing through the body represent the course of the intestine; *b*, end of tibia, showing the tarsus, with the claw, and two accessory spines; *a*, third joint of the spring. Fig. 32, lacinia of maxilla greatly enlarged. Fig. 33, different forms of scales, showing the great variation in size and form, the narrow ones running into a linear form, becoming hairs. The markings are also seen to vary, showing their unreliable character as test objects, unless a single scale is kept for use.)

Fig. 34.



Lepidocyrtus albinos.

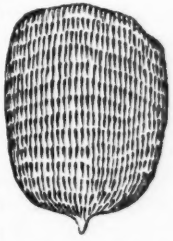
Lepidocyrtus Bourlet. Abdominal segments unequal, with simple hairs and scales. Antennæ long, four-jointed. Eyes eight in number on each side. (Fig. 34, *L. albinos*, an European species, from Hardwicke's "Science Gossip." Fig. 35, a scale. Two species in New England.)

Podura. Abdominal segments subequal. Hairs simple, no scales. Antennæ four-jointed, shorter than the head. Eyes eight in number on each side. Saltatory appendage of moderate length.

Achorutes Templeton. Abdominal segments subequal. Antennæ short, four-jointed. Eyes eight in number on each side. Saltatory appendage quite short.

Fig. 36 represents a species of this genus very abundant under the bark of trees, etc., in New England. It is blackish lead color; *a*, end of tibia bearing a tenant hair, with the tarsal joint and large claw; *b*, spring; *c*, the third joint of the spring, with the little spine at the base; fig. 37, the supposed ovipositor; *a*, the two blades spread apart; *b*, side view. The mouth-parts in this genus are much as in Tomocerus, the maxillæ ending in a lacinia and palpus.

Fig. 35.

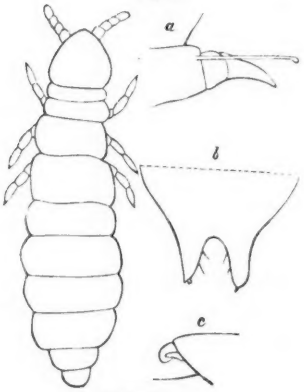


The two remaining genera, Lipura and Anura, are placed in the "family" Lipuridæ, which have no spring. Lubbock remarks that "this family contains as yet only two genera, Lipura (Burmeister), in which the mouth is composed of the same parts as those in the preceding genera, and Anura (Gervais), in which the mandibles

and maxillæ disappear." Our common white Lipura is the European *L. fimetaria* Linn. (fig. 38, copied from Lubbock). The site of the spring is indicated by an oval scar.

Fig. 39 represents a common species of Anura found under stones between tide marks at Nantucket. Compared with Achorutes, the body is rather longer and slenderer and more hairy, while the front of the head is much prolonged, almost forming a beak. The legs (fig. 40) end in a large, long, curved claw. On examin-

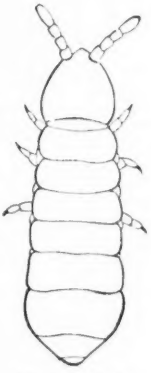
Fig. 36.



Achorutes.

Fig. 37.

Fig. 38.



Lipura fimetaria.

ing specimens soaked in potash, I have found that the mouth-parts (fig. 41, *md*, mandibles; *mx*, maxillæ; *e*, eyes, and a singular accessory group of small cells, which have not been noticed heretofore as far as I am aware) are exactly like those of Achorutes and Lipura. The mandibles, like those of other Poduras, end in from three to six teeth, and have a broad, many-toothed molar surface below. The maxillæ end in a tridentate lacinia as usual, though the palpi and galea I have not yet studied.

For the reason that I can find no valid characters for separating these two genera as a family from the other Poduras, I am inclined to think that they form, by the absence of the spring, only a sub-division (perhaps a sub-family) of the Poduridæ.

The best way to collect Poduras is, on turning up the stick or stone on the under side of which they live, to place a vial over them, allowing them to leap into it; they may be incited to

leap by pushing a needle under the vial. They may also be collected by a bottle with a sponge saturated with ether or chloroform. They may be kept alive in vials for weeks by keeping moist slips of blotting paper in the vial. In this way I have kept specimens of Degeeria, Tomocerus and Orchesella, from the middle of December till late in January. During this time they occa-

Fig. 41.

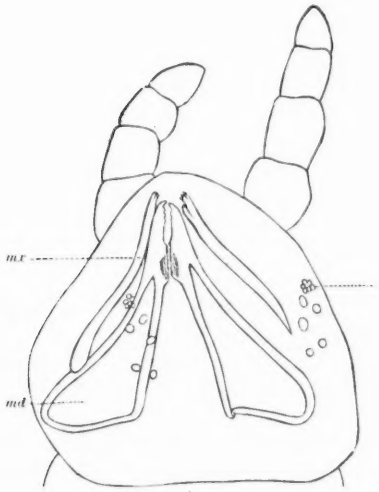


Fig. 39.

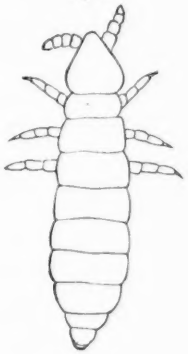


Fig. 40.

Anura.

sionally moulted, and *T. plumbea*, after shedding its skin eat it up within a few hours. Poduras feed ordinarily on vegetable matter, such as dead leaves and growing cryptogamic vegetation.

These little creatures can be easily preserved in a mixture of whiskey and glycerine, or pure whiskey, though without the glycerine the colors fade. The writer would be thankful for specimens both of Poduras and Lepismas, for study.

REVIEWS.

MUSCULAR HOMOLOGIES.*—It is now nearly a century (1774) since Vicq d' Azyr made the first detailed comparison between the anterior and posterior limbs; in doing which he was truly said to have "founded a new kind of comparative anatomy involving a study of the relations which exist between different parts of the body of the *same animal*." His special method of comparison was very defective and has been followed by few; but his general idea of the limbs as similar and *parallel* parts which repeat each other in a *serial* manner one behind the other, has been adopted by nearly all those who have since examined the subject; the exceptions being Gerdy, Foltz, Wyman, and three of the latter's pupils, Folsom, Coues, and the writer of this notice; all these have recognized a *symmetrical* relation between the anterior and posterior regions of the body and the limbs, which was first clearly and impartially discussed by "the most accomplished as well as the most distinguished anatomist of this country,"† three years before the present series of papers began to appear.

Dr. Coues's first paper is occupied with a very clear and intelligible discussion of the general ideas involved in the subject; clear, that is, to those who are already familiar with the "tools of thought" peculiar to this department of knowledge, which is sometimes, with a shade of derision, called "transcendental" anatomy; Dr. Coues accepts the adjective in so far as it expresses "the transcendent importance of investigations that can alone bring order out of a chaotic mass of observed facts, and make a philosophy of anatomy possible." There was some ground for the ridicule heaped upon Oken and Carus and St. Hilaire, who were the pioneers in this, till then unbroken, wilderness of homologies; no wonder the marvellous things which they for the first time beheld, so charmed and excited them that they became, as it were, intoxi-

* Antero-posterior Symmetry, with especial reference to the Muscles of the Limbs. By Elliott Coues, A.M., M.D., Ph.D., Assistant Surgeon United States Army. The Medical Record, N. Y., June 1st, July 1st, July 15th, August 15th, September 1st, October 1st, October 15th, 1870.

† On Symmetry and Homology in Limbs. By Jeffries Wyman. Proc. Bost. Soc. Nat. Hist., June, 1867.

cated with new ideas, and painted what they saw in fantastic and impossible shapes; even in later times there is much that is apparently if not really fanciful in the views of the great English anatomist, whose archetype skeleton made each man a "potential Briareus as to limbs," and it is doubtless true that other cultivators of this field of anatomy have become so entangled in the complicated machinery of their own devising, as to see in the fruitful soil only stones to be cast out, stumps to be uprooted and streams of error to be turned from their channels; all of them facts, for which "so much the worse if they do not accord with my theory."

But the last ten years have brought new laborers into the harvest; crude anatomical speculations have been gradually corrected by the severe criteria of embryology, and such men as Gegenbaur in Germany, Cleland and Flower, Huxley and Humphry, Mivart and Parker* in England, are carefully reviewing all previous works and sifting the grains of truth from the Okenian chaff. Indeed, the science of homologies now fills more or less space in every anatomical periodical, and here in America we are encouraged to this kind of research not only by the general bearing of the works of Agassiz, Dana, and Wyman, but in particular by the paper on "Symmetry and Homology," above named.

In his second paper, Dr. Coues considers the symmetrical homology of the bones of the limbs and adopts the determinations of Prof. Wyman with queries respecting the correspondence of the shoulder and pelvic girdles; a subject which now demands careful revision in the light of Parker's splendid monograph.† The most important of these determinations is one upon which, in fact, the whole matter rests, or which rather expresses the result of the entire investigation, viz.: that the little finger (minimus) is the symmetrical homologue of the great toe (hallux or protos), on the ground of their relative position upon the inner borders of hand and foot respectively, when the former is supinated and brought into its more normal position.

That this is the true morphological way of comparing the hand and the foot, and that the difference in the *numerical composition* of the thumb and little toe would be of very little morphological consequence, even were it constant in the vertebrates, was first, so

*The late Prof. Goodsir devoted much time to morphological investigations.

†Structure and development of the Shoulder-girdle and Sternum. W. Kitchen Parker. Ray Society, 1868.

far as we know, insisted upon by the writer of this notice in a brief communication in 1866* which Dr. Coues appears not to have seen; we allude to it here from our sincere conviction that the recognition by anatomists of the morphological inconsequence of numerical composition as compared with relative normal position will not only aid the solution of many other problems in homology, but will especially enable us to remove what Professor Wyman, as late as 1867,† regards as "the greatest difficulty in the way" of those who adopt a symmetrical homology of the limbs.

The third paper opens as follows: "From what has preceded, it is evident that corresponding muscles are to be sought upon antitypically (or symmetrically) correlated aspects of the limbs, and determined mainly by relation;" but the difficulties found in the application of the principle to the bones are increased tenfold by the complexity of the muscular apparatus, and, at the outset, the author is forced to admit the present impossibility of making satisfactory determinations of the muscles acting upon the humerus and the femur; the *triceps humeralis*, however, and the *quadriceps femoralis* are seen to be homologous in the light of symmetry, even more clearly than they have been previously with the common idea of serial homology; Owen and Goodsir, being apparently the only anatomists who have denied this correspondence.

The outer and inner ham-string muscles give much trouble both on account of their number and their origin from the pelvis, and Dr. Coues finds himself obliged to dissent from previous determinations of their relation to the two flexor muscles of the fore-arm (*biceps* and *brachialis anticus*); his discussion of the homologies of these muscles and of the *poplitæus*, and that respecting the *latissimus dorsi*, and the *supinator longus*, are admirable examples of pure morphological argument, and while the reviewer is not yet fully convinced of the correctness of the conclusions upon these and other mooted points, he is ready to acknowledge, that the general presentation of the muscular homologies is far more ably and fairly presented in this series of papers than in the memoir‡ to which their author so kindly refers; which, by the way, like most theses of anatomical beginners, attempted to cover too much ground, and really accomplished only one thing, the statement of the law of

* On a Cat with Supernumerary Digits. Proc. Bost. Soc. Nat. Hist., May 16th, 1866.
† Op. cit. p. 276.
‡ On Morphology and Teleology. Mem. Bost. Soc. Nat. Hist., vol. 1.

"long" and "short" muscles. Dr. Coues alludes in several places to the necessity of distinguishing between single muscles or muscular organs in different animals, and the muscular "morphological integers" which really ought to be determined before any final decision can be reached respecting symmetrical homologies in the muscular system. He recognizes the fallacy of conclusions drawn from the structure of that singular animal, man, who is in one place described "as the only true biped; no brute has such shoulder-pads, no brute such buttocks." He accepts the reviewer's suggestion* that the present *flexores* and *extensores carpi* are morphologically *extensores* and *flexores* respectively. He also adopts the opinion of Wyman and others, that the patella is a "Sesamoid" bone; but he unfortunately also adopts unquestioned the Owenian theories of the vertebrate skull, and the morphological position of the scapular arch, which are now to be regarded as doubtful, if not altogether disproven.

We have not space here for a detailed account of the author's determinations; the result of the investigation may be given in his own words: "few muscles have not been shown to have correlatives in the opposite limb; of some of these now seeming to have none, correlatives will probably be found; some of the correspondences here laid down are obscure or doubtful; some others are provisional, subject to further revision; most are demonstrably symmetrical, and have been demonstrated so to be."

We would call attention to the very apt and striking comparisons often made by the author; as, for instance, when the stunted caudal segments are styled "*larval*" vertebræ, and the cranial segments "*neural imagines*."

But there are a few matters of general interest connected with these papers which ought not to pass unnoticed. First, they appear in a strictly medical journal, and this may pave the way for discussions which must aid both the practitioner and the morphologist; for the principles of symmetry have already been shown to underlie many of the phenomena of disease in men and animals; and there must be constantly occurring cases which will illustrate and confirm or correct the ideas drawn from pure anatomy. Second, the papers themselves evince a closeness of anatomical observation and a logical power, which promise well for the future of

* Comparative Myology of the Chimpanzee. Bost. Jour. Nat. Hist. 1861. p. 363.

philosophical anatomy in America. And third, these papers are absolutely free from covert flings and sarcasms at opposing theories, and their author has done ample justice to the labors of those whose works he has employed; we must regret the lack of reference to other, and later papers upon limb-homologies, especially those in the "Journal of Anatomy and Physiology." But this was to some extent unavoidable with one who is serving in the army, and is at least atoned for in one way by the assiduity with which the author has made dissections of animals which he could procure. *

This hasty notice has done scant justice to Dr. Coues's work. Let us urge upon all, who are, or wish to be interested in the study of homology, to read this series of papers; we hope before long to publish elsewhere † a more complete review of these productions of our morphological brother; to include therewith a notice of the remarkable paper of Professor Wyman, who is in limb-homologies our common progenitor; to add some suggestions respecting terminology as to both the objects of our study, and the ideas involved therein; to indicate as far as possible, the various minor problems which will occupy us for the half century prior to the probable acceptance of these views by all anatomists; and finally, to append a list of all works and papers bearing upon the question of the homology of the anterior and posterior limbs of vertebrate animals. — B. G. Wilder.

Forms of Animal Life. ‡ — In its plan, arrangement, and the great mass of details and its useful illustrations, this work on comparative anatomy, is the most convenient manual we now have in the English language. Were we going away from libraries, for a sojourn by the sea-side to pursue anatomical studies, we should take with us Gegenbaur's incomparable "Grunzüge der Vergleichenden Anatomie" (Principles of Comparative Anatomy), Huxley's "Introduction to the Classification of Animals," and his "Elementary Lessons in Physiology," but if deprived of these, and one book was to do the work of all, our choice would be Professor Rolleston's excellent compendium.

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* The Opossum and the Ornithorhyncus, among others, have received Dr. Coues's attention and were especially useful in this particular line of research.

† American Journal of Science and Arts.

‡ Forms of Animal Life. Being Outlines of Zoological Classification based upon Anatomical Investigation and illustrated by Descriptions of Specimens and of Figures. By George Rolleston. Oxford, 1870. 8vo. pp. clxviii, 268.

We miss a chapter giving directions to the beginner in the difficult art of dissection. A figure to accompany the explanation of the parts of the skeleton of a rat in order to illustrate the vertebrate skeleton, would also add to the value of the manual.

The classification is mostly taken from the anatomical system of the Germans. In a lineal arrangement, such as the author is obliged to adopt in a book, the Mollusca follow the Vertebrata, then succeed the third sub-kingdom, Arthropoda; the fourth, Vermes; the fifth, Echinodermata; the sixth, Cœlenterata; and the seventh and last, Protozoa.

In looking over the chapter on Arthropoda (Insects and Crustacea) we find some things to criticise. The Cladocera are spoken of on p. cv. as a "family." By some naturalists of high standing, such as Claus and others, this group is considered as a suborder. On p. cix. where certain larvæ of insects are mentioned as having the digestive canal "aproctous," we might add that the larva of Stylops has the intestine ending in a blind sac. On p. 112 it is stated that the "telson, or terminal so-called segment of the crustacea does not appear to possess the characteristics of a true segment." In Limulus, the ninth segment of the abdomen, well marked in the embryo, forms the caudal spine, or telson. It is a small thing to criticise, but throughout the work all the specific names, with very rare exceptions, begin with a capital; thus marring the typography of the book.

Bee Culture.* — Mr. Adair has succeeded in collecting for his annual a number of articles by our leading apiarians comprising much valuable information, both to bee keepers and to students of animal psychology. A proof of this is seen in the first article by Vogel (which we reprinted on p. 17), which contains so much bearing on the theory of evolution, and the principles of breeding.

No art has profited more from the most abstruse researches of purely scientific men, than the art of bee keeping. Huber's hive, the prototype of all our modern hives, was constructed by that philosopher, solely that he might the better watch the habits of bees to gratify his wonderful desire for knowledge for its own sake. The discovery of Parthenogenesis by Siebold and Berlepsch was a purely scientific one, but of the greatest value in the art of

* Annals of Bee Culture for 1870. A Bee Keepers' Year Book. D. L. Adair, editor. Louisville, Ky., 1870. 8vo. pp. 64. 50 cents.

raising bees. Vogel's article shows how much the future of bee keeping depends on the application of physiological knowledge, obtained by the most difficult and abstruse experiments. So much is said by "practical" men of the futility of studying bugs, or cutting up dead or dried plants, or the cruelties of vivisection, or of "scientific toys," such as the microscope or spectroscope, that a reminder of what the world owes to the scientific recluse, is naturally suggested.

In some remarks on "Apicultural Progress" Mr. Elisha Gallup, contrasting the abundant bee literature of the present year with the dearth of bee books in 1846, says "we now have three monthly journals: the American Bee Journal, the Illustrated Bee Journal, the Bee Keepers' Journal, the Annals of Bee Culture [under review]; while there is "scarcely an agricultural paper of any note in the land, that has not its bee department, and all are edited with truthfulness and ability." Mr. Charles Dadant in a "Glance at European Bee Culture," after reviewing its progress in France, Italy and Switzerland, says: "As for Germany, it would take a book to record all the improvements, inventions and discoveries made in that country in the last fifteen years; suffice it to say, that in 1868, there appeared four hundred and twelve publications on bee culture in Germany. This would show that Germany is now the most advanced country in Europe in theoretical bee culture; but in practical bee culture, it is safe to say that Young America is ahead of all."

Regarding the enemies of the bee, other than insects, Professor A. J. Cook says: —

"Insectivorous birds also — chief of which in this case is the King-bird (*Tyrannus Carolinensis*) — are ever on the alert to take the home-returning bees. Nor do they capture only drones, for we have seen their stomachs full to repletion of the little workers. We ought not to kill these birds, for from their insectivorous habits, they are of invaluable aid to the farmer. If the apiary is in a grove, as it should be if possible, these bee-martins will be seen, on a tree or bush, to sit and perch, and do something else; for who has not seen them dart for the passing insect, with unerring aim? and certainly the bees coming home to a hive high from the ground would be more apt to become the victims of these rapacious gourmands.

"But some of our readers have been thinking of, and fearing toads ever since commencing to read this article. Now, as we claim a firm friendship for the toad, loving to watch him in our room and

garden, as he throws out his slender tongue with lightning quickness, taking in the thieving insects which rob us of our delicious fruits, we love to speak a word in his defence. From our observations, we deduce the following: Toads usually seize those bees which fall to the ground; so it is the freighted honey-gatherer, which aims amiss for the alighting board, and thus falls to the ground, that is entombed in the stomach of his Toadship. So from what we have already said, we believe, despite the opinion of some of our best apiculturists, that it is the bees in hives high from the ground which suffer from his Batrachian majesty."

On the subject of breeding in-and-in, Mr. E. Gallup tells us that in "three cases he has known bees to be bred in-and-in without any cross from other stocks, until they became mere dwarfs, and entirely ceased to swarm, or be of any profit to their owner."

At the meeting of the German bee keepers at Nuremburg, Dr. Pollman exhibited a collection of bees illustrative of their natural history. "It was composed of two boxes, containing workers, queens, and drones of the different kinds of bees, such as black, Italian, Greek, Egyptian, etc., and of different parts of the bodies of bees, hermaphrodites, insects hostile to bees, scales of wax of all sizes, broods, foul broods, combs, &c."

NATURAL HISTORY MISCELLANY.

BOTANY.

Climbing Fern.—The beautiful Climbing Fern (*Lygodium palmatum*) exists and flourishes in its wild state within the borders of "old Essex." The writer discovered this rare and attractive plant in 1869, while exploring "Lynn Woods" in the vicinity of the famous "Penny Bridge." The locality of its haunt is within the limits of Saugus, and not far from that romantic spot known as the Pirates' Glen. Specimens have been obtained having a stalk or "vine" nearly four feet in length. As the climbing fern is one of the most rare, graceful and attractive plants found in this country, it is a matter of satisfaction to know that we have it growing in our woodland valleys. This fern has been found, though rarely, in Florida, Kentucky and Massachusetts. In Virginia it is often seen, and it has been found in several localities

between that state and our own. Some very fair specimens have been obtained in Concord, not far from Thoreau's favorite Walden woods. At East Windsor Hill, Conn., at one time abundant supplies were obtained for decorative purposes, but so careless were the people who sought this dainty "vine" that the Legislature passed an act forbidding its heedless and wanton extermination. The name *Lygodium* is from the *Greek* signifying *flexile* or *flexible; palmatum* suggests the resemblance of the outlines of the fronds to an outspread hand. Success in transplanting the "Climbing Fern" depends much upon the care exercised to obtain good roots. Having these, little complaint will be made of the difficulty attending the culture of one of Nature's daintiest eccentricities. — Geo. E. Emery.

Parasitic Fungi in the Human Ear. — In the "Bulletin de la Société Imperialé des Naturalistes de Moscou" for 1870, No. 1, just received, is a paper by Dr. Karsten on the parasitic fungi found in the human ear, accompanied with beautiful illustrations. The author confirms the statements of Hallier and other previous observers, that when the spores of these parasitic fungi are sown elsewhere, the plants which result from them assume very different forms, according as the substance on which they are sown is rich or poor in material for nutrition; and that fungi described as distinct species, or even as belonging to different genera, are merely different genetic forms of the same plant.—A. W. B.

Red Snow in Washington Territory. — In the summer of 1858, when employed on the survey of the boundary between the Territories of the United States and those of Great Britain (the 49th parallel of north latitude), I ascended the main range of the Cascade Mountains, a little south of the line and at an elevation of about 6500 feet. While looking for a camping place, one of my men, with an expression of horror, brought me a handful of *red snow* which he had picked up on a higher neighboring point, and asked what it was. His disgust can be imagined when after inquiring where he had obtained it, I eat it. Accompanying him back I found that the color was, so to speak, "sheeted" over a considerable space on the northern side of a point of rocks. As it lay in place, it was of a pink color, beautifully contrasting with the white bank on which it lay. Compressing it in the hand, it gave a bloody tint to the water which oozed from it. The taste

seemed somewhat earthy. I had no other means of examining it than a pocket lens, under which the coloring matter seemed to consist of tadpole shaped bodies, with rounded heads and attenuated tails, perhaps two lines in length. I afterwards met with the same phenomenon on the range dividing two branches of the head waters of the Similkameen mountains, a little east of the Cascades, and at the height of about 6000 feet. The coloration of the snow was unequal — somewhat in bands or clouds, or, as I have above expressed it, "sheeted," and it rarely penetrated above a few inches. I believe this is the first notice of the occurrence of the "red snow" within the territories of the United States. — GEORGE GIBBS.

FERTILIZATION OF FUMARIACEÆ. — Professor Hildebrand of Bonn contributes to Pringsheim's "Jahrbuch für wissenschaftliche Botanik" for 1870, a continuation of his observations on the mode of fertilization of different races of plants, referring especially to the order Fumariaceæ. He finds that in all plants belonging to this order the access of pollen to the stigma of the same flower is unavoidable, with the exception of Hypecoum, in which the stamens are distinct. In the genera with diadelphous stamens (Fumaria, Corydalis, Dicentra, etc.), the pollen falls immediately on to the stigma, which is in close proximity to the anthers, and is developed precisely at the same time. This does not, however, necessarily imply self-fertilization, as insects carry off the pollen to other flowers to fertilize them. By artificial impregnation Prof. Hildebrand obtained similar results to those published by Darwin in the case of other plants, that a pistil fertilized by pollen from its own stamens does not produce so many seeds as one fertilized by foreign pollen. Hypecoum is somewhat protandrous (stamens ripening before pistil). — A. W. B.

FERTILIZATION OF DICHOGAMOUS FLOWERS. — While Professor Hildebrand has been prosecuting his researches in Germany, Professor Delpino of Florence (now Botanical Professor in the Forest Institute at Vallombrosa) has been following up similar lines of inquiry in Italy, with equal success. In his recent papers, entitled *Ulteriori Osservazioni sulla Dicogamia vel Regno Vegetale* — of which the first part fills almost two hundred and fifty octavo pages, and the first fasciculus of the second part, forty pages more — he has illustrated the very diversified arrangements in many

natural orders with hermaphrodite blossoms, which secure cross-fertilization as effectively as if the flowers were of distinct sexes. This treatise is a treasury of observation upon this subject. We have also from the same author an Italian version of a lecture by Dr. E. Müller, on the application of the Darwinian theory to flowers and to the insects visiting the flowers, with extended notes — the whole of which is worthy of an English version. — Eds.

Lichens. — Since the article entitled "Lichens under the Microscope" was written, I have met with a notice in Krempelhuber (Geschichte der Lichenologie, vol. i, p. 431) of three fossil lichens, one related to Ramalina, a second to Verrucaria, and a third to Opegrapha; the first two found in the "Keuper," or upper new Red Sandstone, and the third in chalk.

In regard to the number of the species, it ought perhaps to have been stated that Krempelhuber's enumeration includes all synonymes and doubtful species, in short everything to which a separate name has been attached. Nylander (Synopsis, 1859) gives the number of species at 1361, which is probably considerably below the real number. — H. W.

ZOOLOGY.

Notes on American Deer. — I wish to make an early correction through the Naturalist of an error in my observations as given in my paper entitled "American Cervus." On page 7 of that paper, I stated that the elk (*C. Canadensis*), like most other quadrupeds, has but one pelage a year. I can now state that it sheds its coat twice a year like all the other species of that genus, which I have had an opportunity of studying.

The shades of color, and the length of the hairs, of the summer coat and its successor, are so nearly alike, and the former is shed and replaced by the latter so gradually, that it is exceedingly difficult to detect the change even when the attention is called directly to it.

In anticipation of some more extended observations on this branch of natural history, allow me to notice a very marked physiological difference between the elk and the three smaller species of the same genus which I now have in my grounds (*C. Virginianus*, *C. macrotis* and *C. Columbianus* Rich). In the elk the

theca extends along the abdomen to within three inches of the umbilicus, and has no pendant prepuce, almost precisely as is observed in the Bos family. In the three smaller species named the theca is suspended from a point so near the scrotum that when the animal is standing it occupies a vertical position within half an inch of it, the posterior measurement of which is three to four inches, anterior measurement half that length. The lower half may be described as an exaggerated prepuce, which is entirely wanting in the elk. In this regard but little difference is observed in the three smaller species.

It would be interesting to know to which of these species the moose (*C. alces*) most conforms in this particular, and I hope that you, or some of your correspondents will be able to inform us. — J. D. Caton, *Ottawa, Ill., Nov.*, 1870.

Occurrence of Kirtland's Owl in Maine. — A characteristic specimen of the *Nyctale albifrons* Cassin, was shot at Norway, Me., September 14th, by Mr. Clarence M. Smith, and by him presented to the museum of Yale College. It has not been hitherto recorded from New England. So far as known to me, the specimen taken at Racine, Wis., by Dr. Hoy, is the only one previously recorded from the United States. Prof. Baird mentioned another specimen collected by Dr. A. Hall, near Montreal, and in a recent number of the "Canadian Naturalist" (vol. v, p. 103) a specimen is recorded as obtained near Quebec, by Rev. D. Anderson. The early date would indicate that the specimen taken at Norway was resident there, as it was before the southward migration had commenced. In a recent letter Prof. Baird expresses doubt whether the *albifrons* may not prove to be the young of *N. Acadica*. But if so, it is singular that the young of the latter has not oftener been observed in localities where it is common, as in many parts of New England. This question is well worthy of thorough investigation. — A. E. Verrill.

Spawning of the Capelin. — The Capelin (*Mallotus villosus*), an inhabitant of the northern seas of the Atlantic coast of America, is well known as a bait for cod-fish. It visits the shores during August and September, for the purpose of spawning, when it is so abundant as to darken the sea for miles. There are some peculiarities about the method of its spawning; the females, on approaching the beach, being attended by two males, who hold

the female between them, by means of the ridge of closely set, brush-like scales with which the males alone are provided, so that she is almost entirely concealed. In this state the three run together with great swiftness upon the sand, and in this act the spawn issues from the female, which is simultaneously fertilized. An immense business is carried on in the capture of the capelin as bait for the cod; the French fishermen alone obtaining from the fishing ground off Newfoundland, from sixty thousand to seventy thousand hogsheads annually for this purpose.

Ornithological Notes. — In J. A. Allen's "Notes on Some of the Rarer Birds of Massachusetts," in the Naturalist for January, 1870, he says of the Glossy Ibis (*Ibis Ordii*), "It was also taken, as I learn from Mr. Vickery, in New Hampshire, in October, 1858, by Dr. Palmer." I have the specimen in my collection now, an old bird, in full plumage, taken near Lake Winnipiscogee, in the town of Alton, N. H. I have also the Canada Jay (*Perisoreus Canadensis*), and Black-backed, Three-toed Woodpecker (*Picoides arcticus*), both taken in Strafford, N. H. The jay I shot in winter, and the woodpecker was taken late in the fall. I believe the Canada Jay is not mentioned by Mr. Allen as occurring in Massachusetts. It is not improbable that it may be an occasional winter visitant. The Pine Grosbeak (*Pinicola Canadensis*) has appeared in Ipswich during the winters of 1867–68, and 1868–69. I secured one in red plumage, but they were mostly young birds. — Charles Palmer, *Ipswich*.

Mimicry in Insects. — At a recent meeting of the Scientific Committee of the Horticultural Society, a remarkable paper was read by Mr. Andrew Murray, on the subject of Mimetism, especially as exhibited in the instances of the South American butterflies, which have already been discussed in our columns. Mr. Murray adduced a number of arguments which he considered told against the theory that the mimicry had been produced by Natural Selection, and attributed it to hybridization. — *Nature*.

Parasite on the Wasp. — Mr. F. Smith exhibited to the Entomological Society of London, *Phora florea*, a dipterous parasite in the nest of the wasp. We have figured and noticed in the Naturalist, vol. 2, p. 196, a similar parasite in the cells of the honey bee living in Europe. Similar flies should be looked for in this country by our enterprising bee keepers.

Ringneck Duck. — Mr. G. A. Boardman of Calais, Me., writes that he found several flocks of the Ringneck Duck, *Fulix collaris*, breeding on the river, near Calais, the past season, and that he secured the old and "chicks." He states that he knows of no other instance of this duck breeding in New England.

Mocking Bird in Maine. — I found a mocking bird, *Mimus polyglottus*, in the woods up the river this past season. This is the first time the bird has been found in Maine, to my knowledge, and I think it could not have been an escaped cage bird. — G. A. Boardman, *Calais, Maine.*

Red Squirrels not Red. — I received in November last a very pretty black specimen of the *Sciurus Hudsonius*, and also a pure white specimen of the same species. — G. A. Boardman, *Calais, Maine.*

GEOLOGY.

Devonian Rocks in the Amazonian Valley. — At the foot of the celebrated Serra do Ereré, rechristened Monte do Agassiz by Dr. Silva Continho, in the Province of Grao Pará, Brazil, is an extensive plain on the northern side, composed of coarse shaly sandstones of a reddish color, red, white, and black shales, and very hard cherty beds, all lying quite horizontally, but broken through by a perfect network of heavy trap dykes, which appear on the surface of the plain like ruined walls. The sandstone beds contain fossils of which I secured a large collection. They comprise one or more species of *Dalmanites* of which I have fragments kindly determined for me by Professor James Hall, *Chonetes?*, *Spirifer*, *Leptocœlia*, *Orthisina*, *Orthis?*, *Lingula*, *Discina*, *Tentaculitz*, *etc.* In a *relatorio* published in the "Diario do Grao-Pará" of Pará, January 5th, 1871, I referred this series of beds to the Devonian. A small collection of the above fossils was referred to Professor Hall, who writes me that "the forms and associations are of Devonian character, and the impression produced from the *tout ensemble* is that they are of the age of the Upper Helderberg group."

We have now the Devonian age of the Ereré beds, I think, definitely settled, and it is interesting that these are the only Brazilian rocks that we can satisfactorily refer to that age.

These Devonian rocks, lying quite horizontally, reach close up to the base of the Serra do Ereré, and run along it for some distance. The Serra is composed of heavy beds of coarse sandstone, with a slight admixture of feldspathic clay, and so exceedingly compact that a fracture passes through the grains of sand. This is the general character of the rock; some is not so compact, and there are one or two comparatively thin beds of hardened feldspathic clay. The rock is without fossils. The whole series dips towards the southeast approximately, the angle being in some cases as high as 15°–20.° I studied this locality for a month, and I came away with the only conclusion that seemed legitimate, viz.: that the Serra was older than the Devonian rocks of the plain to the north. It is not a table-topped Serra, and does not belong to the same system as the table-topped hills of Almeirim, Paraúquára and Santarem, which I believe to be Tertiary. The group of hills of Ereré and Paitúna, is entirely different from anything else I have seen on the Amazonas, and it seems quite unique.

I did not find the geological structure of the Amazonian valley as simple as I expected. Along the line of the main river it is very monotonous. So it is along the lower Mississippi, but the valley is bordered by older rocks, Eozoic, Silurian?, Devonian and Carboniferous. Nor are the clays, etc., so uniform in their distribution as I expected to find them. I have seen clays from the Devonian, Carboniferous and Tertiary so exactly alike that it would be impossible to distinguish them, in the hand specimen, from the recent clays.

I am preparing a report on my geological studies on the Amazonas, which I shall publish as soon as possible. — Ch. Fred. Hartt, *Jan. 17th*, 1871.

Origin of Diamonds. — Professor Morris has started a new theory as to the source whence diamonds are derived. Hitherto they have been looked upon as coming from igneous and metamorphic rocks, like garnets, rubies, and many other precious stones; a better knowledge of the geology of the diamond district of South Africa, leads us to conclude that these stones come from certain stratified beds containing, besides reptilian remains, numerous plants and much fossil wood. These beds are known as the "Karoo" or *Dicynodon* beds. Professor Morris calls to mind the remarkable fact (well known to botanists and mineralo-

gists) that in the stems of the bamboo small crystals of quartz are found, known by the name of *tabasheer;* he suggests, whether it may not be possible that the diamonds yielded by these old plant beds similarly owe their origin to vegetable growth. The idea is well worthy the attention alike of the chemist, the mineralogist and the botanist. — *The Academy.*

Discovery of Actual Glaciers on the Rocky Mountains.— Mr. Clarence King announces in the March number of the "American Journal of Science and Arts," the fact that while "extinct glaciers, equalling in all respects the former grandeur of the alpine system," were discovered by Prof. Whitney and his corps, there are still in existence glaciers on the northern side of Mt. Shasta in Northern California, "the largest about four and a half miles in length, and two to three miles wide." Glaciers have also been found by Mr. Emmons on Mt. Tachoma, or Rainier, and on Mt. Hood by Mr. Hague. On the former mountain (Rainier) : —

"The main White River glacier, the grandest of the whole, pours straight down from the rim of the crater in a northeasterly direction, and pushes its extremity farther out into the valley than any of the others. Its greatest width on the steep slope of the mountain must be four or five miles, narrowing towards its extremity to about a mile and a half; its length can be scarcely less than ten miles. The great eroding power of glacial ice is strikingly illustrated in this glacier, which seems to have cut down and carried away on the northeastern side of the mountain, fully a third of its mass. The thickness of rock cut away, as shown by the walls on either side, and the isolated peak at the head of the triangular spur, in which the bedding of the successive flows of lava forming the original mountain crust, is very regular and conformable, may be roughly estimated at somewhat over a mile. Of the thickness of the ice of the glacier, I have no data for making estimates, though it may probably be reckoned in thousands of feet."

Eozoon Canadense. — Some doubts having been thrown on the organic origin of this oldest known geological form of life by a correspondent in "Nature," Dr. Carpenter has been induced to recapitulate the arguments in favor of the organic theory; and has also brought from Principal Dawson of Montreal, in "Nature" for February 9th, an account of recent explorations and observations in the Laurentian rocks of Canada, which seems fully to establish the claims of *Eozoon* to the character of a veritable fossil. — A. W. B.

THE BOTTOM OF THE SEA OFF THE EASTERN UNITED STATES.—At the meeting of the Boston Society of Natural History, Nov. 16, the President introduced Count L. F. de Pourtales, who spoke on the constitution of the bottom of the ocean off the east coast of the United States, south of Cape Hatteras, as developed by the soundings and dredgings of the United States Coast Survey.

The chief constituent, he said, is silicious sand, from the coast line to about the one hundred fathom line, a limit which also coincides nearly with the inner edge of the gulf stream for a great portion of its course. Outside of this line the whitish, calcareous "Globigerina" mud prevails and extends probably under the greater part of the ocean. The silicious sand is replaced to the southward of the Vineyard Islands, and off the eastern end of Long Island, by a greenish or bluish mud, known by the navigators as the Block Island soundings. Similar mud is found off Sandy Hook in a range of depressions known as the mud-holes, which form a leading mark to find the port of New York in thick weather. In the neighborhood of New York a few rocky patches are found which require investigation. Near Cape Fear, also, rocky bottom is sparingly found, affording a foothold to some corals, gorgonias and sponges. Otherwise the sand is pretty uniform in constitution, varying only in the size of the grain.

A remarkable deposit of green-sand is found on the inner edge of the Gulf Stream, off the coast of Georgia and South Carolina. The bottom consists here chiefly of living and dead foraminiferæ, the chambers of the latter becoming filled with a silicate which injects even the finest ramifications of the canals of the shell. At first yellow, it gradually turns green, at the same time the shell proper decays and breaks off, leaving a cast, which by attrition and conglomeration with others often loses the characteristic form of a cast. Sometimes black pebbles are found, of which a section shows plainly the origin due to an agglomeration of casts of foraminiferæ.

The dredgings made by the Coast Survey in the Straits of Florida have revealed the existence of a large bank, or deep sea platform off the Florida Reef, consisting of a highly fossiliferous limestone still in process of formation from the numerous shells, echinoderms and corals, mostly new to science, which live on it, at a depth of from one hundred to three hundred fathoms. Between this platform and the reef, the bottom consists of the detritus of

the reef, more or less finely comminuted and not rich in animal life. In depths beyond the three hundred fathom line, but with considerable variation in its limits, we find again the Globigerina mud which also fills the greater part of the Gulf of Mexico in deep water.

The Coast Survey intends to prosecute these researches next year with increased means.

Fossil Whale in the Drift. — The bones of a whale closely allied to the White Whale (*Beluga leucas*) of the Gulf of St. Lawrence, have been discovered at Cornwall, Ontario County, Canada. It seems to be the same as the *B. Vermontana* of Thompson.— *Nature*.

MICROSCOPY.

Photo-Micrographs for the Stereoscope. * — Before the suggestion in Carpenter's last edition on the Microscope, that stereoscopic pictures might be obtained by photographing a microscopic object alternately with the two sides of an objective, I had been working on the subject with some degree of success. Dr. Carpenter, however, seems to mention the fact rather as a means of convenient illustration, or a scientific curiosity, than as the expedient of great practical utility that I conceive it to be.

Two or three methods seem to be applicable to the production of such pictures. Some objects, somewhat equal in width and depth, and visible under a lens of long focus, may be tilted by a simple, graduated, and carefully centred mechanical arrangement, first toward one side, and then equally toward the other, photographing each aspect by the same power and under essentially the same conditions: or, of certain objects under low and medium powers, a conception of solidity may be gained, by using photographs which are identical, except that, by a slight change of focus, they represent different planes of the object: or, the object and lens remaining unchanged, the lateral halves of the objective may be alternately stopped off, either directly, or by means of stops under the achromatic condenser, or by means of an achromatic condenser (of very small angular aperture) inclined first toward

*From remarks by Dr. R. H. Ward, at a meeting of the Troy (N. Y.) Scientific Association, Feb. 20th, 1871.

one side and then toward the other, so that each picture shall represent the view actually taken of the object by each side of the objective. The latter method of the three, is doubtless the one most generally applicable in practice.

Pictures formed in this manner, and mounted upon cards ready for use in the ordinary stereoscopes, would greatly excel in elegance and definiteness any present means of disseminating results in many branches of microscopical study. As a means both of popularizing the familiar facts of microscopy, and of interchanging among microscopists the knowledge of novel results of investigation, they would be invaluable. Few objects, for instance, would be more interesting to persons of general, if not scientific culture, than excellent stereoscopic views of the structure of plants, insects, and other familiar natural objects; and almost any microscopist would be glad to possess similar views representing the latest researches into the structure and relations of tissues, the micro-chemistry of poisons and adulterations, or the anatomy of typical species in any family of microscopic organisms. Such pictures might be usefully prepared by any public institution, and distributed to scientific institutions and societies; or, preferably, prepared by some scientific, not sensational, private source, and furnished to buyers, like Dancer's micro-photographs, through the ordinary channels of trade.

In order to photograph, without delay, any field of view which a working microscopist deems worthy of preservation, he should have a camera mounted on a plank which is blocked at one end for the feet of the stand used as a "working instrument." Then, whenever desired, the eye-piece is removed, the instrument levelled into a horizontal position and placed accurately on the plank, and the magnified image instantly thrown upon the focussing plate of the camera. Finding the usual band, passing around pulleys and over the fine-adjustment wheel, to be a slight annoyance in carrying out this plan with the stand I ordinarily use (a large stand of the "Jackson" model), I make the fine adjustment by a somewhat soft cylinder of India-rubber lying upon the wheel. This cylinder is rather more than three inches long, is an inch and a half in diameter, and weighs about four ounces. It is open through its centre, like a tube with thick walls and small bore, and is mounted upon one end of a straight, light, wooden rod, the other end of which is supported on or near the top of the camera.

It is prevented from rolling off from the fine-adjustment wheel by a horizontal wire, transverse to the axis of the apparatus, attached by a hinge-joint to a post at the side of the plank, and to a pin in the end of the wooden rod which just passes through the cylinder; and being retained not over the centre, but somewhat to one side of the wheel, loss of motion is simply impossible, and an extremely fine and manageable motion is secured. The unequalled facility and certainty with which this apparatus can be instantly laid upon the fine-adjustment wheel or turned back from it, is sufficiently evident.

Microscopy at the Army Medical Museum.—The Medical Society of the State of New York, one of the largest and most influential organizations of the kind in this country, at a recent meeting adopted a series of resolutions expressing its interest in and appreciation of the microscopical work of the United States Army Medical Museum at Washington. The Society approves, with some degree of enthusiasm, the methods of investigation, and of disseminating results, employed at the Museum, especially in regard to the study of healthy and diseased tissues; believing that the progress attained is of material use to the profession, and that it would be unattainable at present without the unusual facilities furnished by the Government.—R. H. W.

NOTES.

Mr. Boucard, the well known dealer in specimens of Natural History, and traveller, formerly living in Paris, but now resident in London, proposes the publication of a work on the Coleoptera of Mexico and Central America, including the adjacent portions of the United States, especially the Pacific region. He earnestly desires contributions of specimens, whether named or not, to be used in his investigations, and will return such as he is not permitted to keep, suitably identified, and will render an equivalent in other specimens, if desired, for such as are sent to him to be retained. Any specimens intended for him may be sent through the Smithsonian Institution, or direct to his establishment in London, 55 Great Russell street, Bloomsbury, W. G.

A rare opportunity of securing specimens of insects from Texas and Southern New Mexico, is now open to those interested. By reference to the advertising pages it will be seen that Mr. Belfrage is to make a long collecting journey through the above named region. We can recommend him as a faithful and excellent collector. His specimens arrive in excellent condition.

The excrements of bats from Egypt have recently become an article of trade as a sort of guano for manure.

It has been announced at the Royal Geographical Society that Livingstone has arrived at Ujiji on his return journey.—*Nature.*

ANSWERS TO CORRESPONDENTS.

E. S. M.—The plants are:—1, *Utricularia purpurea*; 2, probably *Claytonia Virginica* (poor specimen); 3, *Sagittaria calycina* var. *spongiosa*; 4, *Spiræa*; 5, *Hydrocotyle Americana*; 6, *Phaseolus trilobus.*

A. G. H.—The cocoon of *Platysamia Cecropia* was filled with the cocoons (containing the perfect insects) of an Ichneumon.

W. O., Montreal.—Professor J. Leidy, Philadelphia, Professor A. E. Verrill, New Haven, and Professor H. J. Clarke, Lexington, Ky., are the only persons in this country who are engaged on the subject of internal parasites, so far as we are informed. Dr. Weinland has been in Germany for many years.

BOOKS RECEIVED.

A Concise Analytical and Logical Development of the Atmospheric System, and of the Elements of Prognostication, by which the weather may be forecasted, adapted to the Practical Mind of the Country. By Thomas B. Butler, author of the "Philosophy of the Weather." Revised Edition. Andrew Selleck, Norwalk, Conn. 1870. 12mo, pp. 405. Cloth.

Bulletin of the Museum Comparative Zoology, Vol. II, No. 2. Preliminary Report on the Crustacea Dredged in the Gulf Stream in the Straits of Florida. By L. F. de Pourtales, Assist. U. S. Coast Survey. Part I, Brachyura. By Dr. Wm. Stimpson, 1870. 8vo pamph., pp. 52.

Annual Report of the Surgeon General United States Army. 1870. 8vo pamph., pp. 10.

The Earthquake of October 20, 1870. By Principal Dawson, LL. D., F.R.S., etc. pp. 8. 1870.

Report on the Progress of the State Geological Survey of Michigan. By Alexander Winchell, Director. Lansing, 1871. 8vo pamph., pp. 64.

Descriptions of Some New England Nudibranchiata. By A. E. Verrill. 8vo, pp. 4. Nov., 1870.

Report on the Geological Survey of the State of Iowa, to the 13th General Assembly, Jan., 1870, containing results of examinations made within the years 1866, 1867, 1868 and 1869. By Charles A. White, M.D. 2 vols, cloth. Imperial 8vo, pp. 734. Plates and maps. Des Moines, 1870.

Report of an Inquiry in regard to Schools of Technical Science in certain portions of the United States. By J. G. Hodgkins and A. T. Machattie. 8vo pamph., pp. 34. Toronto, 1870.

Third Annual Report of the Natural History Club of Philadelphia. 1871. 8vo pamph., pp. 24.

Fourth Annual Report of the Commissioner of Fisheries of the State of Maine for the year 1870. 8vo pamph., pp. 56. 2 plates.

Fifth Annual Report of the Commissioners of Inland Fisheries [of Massachusetts]. January, 1871. 8vo pamph., pp. 77.

On the Genesis of Species. By St. George Mivart, F.R..S 12mo, cloth, pp. 296, illustrated. London. Macmillan & Co. 1871. [$2.00.]

Honduras; Descriptive, Historical and Statistical. By E. G. Squier, M.A., F.S.A., etc. Issued by permission of the author, and under the authority of His Excellency Don Carlos Gutierez, Envoy Extraordinary and Minister Plenipotentiary of the Republic of Honduras in Great Britain. 12mo, cloth, pp. 278 and map. London. Trubner & Co. 1870.

Travels in Central America, including Accounts of Some Regions Unexplored since the Conquest. From the French of The Chevalier Arthur Morelet. By Mrs. M. F. Squier. Introduction and Notes by E. Geo. Squier. 12mo, cloth, pp. 430, illustrated. New York. Leypoldt, Holt & Williams. 1871.

Report of the Fruit Growers' Association of Ontario for the year 1870. *[Including 1st Annual Report on Noxious Insects.]* 8vo pamph., pp. 130. Toronto, 1871. [Gov. Doc.]

NATURAL HISTORY IN THE PUBLIC SCHOOLS.

THINKING that a strong effort should now be made for the encouragement of the study of Natural Science in the Public Schools of the country, the editors of the NATURALIST have (in connection with several most eminent educators) recently asked the Legislature of Massachusetts to grant a small appropriation for the purpose of supplying regularly the higher schools of the State with copies of the NATURALIST, believing that beneficial results, both to the teacher and scholar, would follow the perusal of its pages, and that by presenting the subject to the scholar in this form, a love for the study would be awakened, which it is impossible to secure simply from text books, that are in themselves repellant to the beginner.

The Legislature of Massachusetts referred the petition to its Committee on Education, and that Committee, with full appreciation of the importance of the subject, gave a hearing to those interested, on the ninth of March, when the following letters were read, and remarks were made by several gentlemen on the importance and probable satisfactory results of the plan.

We regret that no report was made of the remarks of Hon. Joseph White, Secretary of the Massachusetts State Board of Education. This gentleman endorsed the proposition as one well worthy of being tried by the State, and while believing that good results would follow, said that the plan was an experiment, but as it was an experiment in the right direction he thought it should be tried, and as Secretary of the Board of Education he was convinced that the copies could be distributed advantageously among the schools.

The decision of the Legislature has not yet been given,* but believing that the plan will meet with advocates in other States, as well as in Massachusetts, and hoping to see it tried elsewhere, we have concluded to print such portion as we have in writing of the testimony given before the Massachusetts Committee, for the perusal of those in other States who may be friendly to the cause.

Avoiding argument in this place, we will only remark, in anticipation of some replies, that the NATURALIST was not established as a pecuniary speculation, and is maintained by the fostering care of the Trustees of the Peabody Academy of Science, as one of the means of carrying out the wishes of the founder of the Academy, who, ever thoughtful of the benefit of mankind, distinctly enjoined upon his trustees the promotion of Science and Useful Knowledge, not only in his native county, but in "our Commonwealth and common country."

* Since this was put in type the Committee on Education have reported favorably.

[*Letter from Professor Agassiz.*]

EDITORS OF THE AMERICAN NATURALIST:

CAMBRIDGE, March 6, 1871.

Dear Sirs: — The time seems to have come when to the received methods and approved topics of popular education such branches of physical and natural sciences should be added as have acquired real importance for the business of life during the last fifty years. There is only one difficulty in the way of this most desirable object. There are no teachers to be had — not enough to be found in the whole State of Massachusetts simply to provide the Normal Schools — whatever efforts might be made to introduce these studies at present, and the demand is likely to become more pressing every day. It would seem, therefore, to be the part of wisdom to consider what may be done to prepare the way. For years past I have been urging upon the educational section of the Social Science Association, the desirableness of introducing a complete course of scientific instruction in our Normal Schools, not from text books, but with experiments and demonstrations by special teachers; and I now hold that it would be still better to organize a special Normal School for the training of scientific teachers. The world will require them everywhere before many years are passed, and it would be fitting that, in the United States, Massachusetts should set an example, timely, in the right direction. But even this must be heralded in some way or other, and I see no better or more efficient way than the circulation of sound information upon the topics regularly to be taught. Your desire, therefore, to give to the AMERICAN NATURALIST a wider circulation among the schools, and throughout the State, meets fully my approval, and I will support your efforts in every way that may appear practicable. It would be a step in the right direction if you could secure for your periodical the same facilities and aid which are granted to the "Massachusetts Teacher," as the AMERICAN NATURALIST is

doing, in an able manner, in the department of natural history, what the Massachusetts Teacher is aiming at in the general field of school instruction. Moreover, it can fairly be said that the volumes of the AMERICAN NATURALIST thus far published would afford to teachers most desirable information in their preparation for the new task.

Wishing you ever so much success in the furtherance of your enterprise,

I remain, very truly yours,

L. AGASSIZ.

[*Letter from Professor Gray.*]

CAMBRIDGE, MASS., March 7, 1871.

Dear Mr. Putnam: — It unfortunately happens that I have a lecture on Thursday at 11 o'clock, which I cannot postpone, and which will prevent my going in to meet your committee. I wish you would say, in my behalf, that I think your application one eminently fit to be made, and I hope it may prevail. As you know very well, I have followed your journal with interest and attention, and I must say that you have achieved a great and rare success in making the AMERICAN NATURALIST at once *truly scientific* and *truly popular*, and I have good occasion to know that this is a thing not often done. Yet in an educational view this is all important. Then your typography and illustrations are first rate and you deserve encouragement for that. I know that while your journal does efficient service at home, and aims simply at that, it is very highly thought of in Europe, as well it may be.

If there should be a second hearing, and you think I could be of any use, I should like to say what I think of it to your committee.

I can write only this hurried line.

Believe me to be yours, most sincerely,

ASA GRAY

[*Letter from Mr. Hagar, Principal of the State Normal School.*]

STATE NORMAL SCHOOL, SALEM, MASS.,
March 9, 1871.

F. W. PUTNAM, Esq.:

Dear Sir:—I regret that my school duties will not allow me to be present to-day at the legislative hearing in reference to the AMERICAN NATURALIST. I should be glad to say a word in behalf of that most valuable publication. Having taken it from the first, I have had an opportunity to judge of its merits, and I am clearly of the opinion that it is admirably adapted to awaken and promote in the minds of those who peruse it a lively interest in the study of Natural History.

It seems to me that if the Legislature of Massachusetts should furnish the means of placing the NATURALIST in the several school libraries of the State, or, at least, in the hands of the teachers of high schools and the principal grammar schools, it would do much toward building up a department of education which is now generally neglected, though of great importance.

I earnestly hope that the Committee on Education will regard with favor your application in behalf of the NATURALIST, and that the Legislature will aid you in your laborious efforts to introduce more of practical science into our public schools.

Yours truly,

D. B. HAGAR.

[*Remarks by George B. Emerson, LL.D.*]

Mr. Chairman:—I think it of the utmost importance, in the education of every child, to open his eyes, as early as possible, to the beauty, properties, and curious structure of the objects around him. This will lead him to form the habit of observation upon the simplest objects, will add to his capacity for observation and thought, and will open to him a

source of great and inexhaustible happiness throughout life. A person whose habits of observation are thus formed, will be insensibly led to occupy himself more with the works and thoughts of God, than with man's works and thoughts; and he will see and learn a thousand things, which, without these habits, would have remained unseen and unknown. To the future farmer these habits will be of special use. Every farmer ought to be an observer. He cannot otherwise understand the management of the earth he tills, or of the vegetables and fruits he cultivates, nor how to provide for his friends, the birds, or against his enemies, the insects. The AMERICAN NATURALIST seems to me admirably well adapted to form this habit of observation, and to awaken and gratify a love of the beautiful. I should be glad to put it within the reach of every teacher in all the schools of the state.

For more than half a century I have had no higher ambition than to be a successful teacher.

Not many years after I came into this town, in 1821, to be the first Principal of the English High School, I was one of a few, who, meeting first in the office of Dr. Walter Channing, united to form the Boston Society of Natural History. After a few years I became president of this society, and continued in the office for some time. I did not feel as if I were neglecting my chosen work in giving a portion of my time to Natural History. I needed recreation; and in what more suitable form could I find it than in taking long walks with Dr. Charles T. Jackson, or A. A. Gould, or D. H. Storer, to Roxbury or Malden Hills, or Chelsea Beach, or a drive with Prof. J. L. Russell, to see Wm. Oakes at Ipswich, or with Oakes himself, to the Essex woods, or to examine the trees in West Cambridge? This was recreation in the open air, with an interesting object in view. I wish that every teacher, worn with confinement and anxious toil, could get refreshment in the same way. The subject of suitable exercise and refreshment for the teacher is of vital importance. Many of the best and most

devoted teachers, especially females, are breaking down, from time to time, for want of air, exercise, and sunshine. The looking for objects for their lessons in Natural History would give them the very variety they want, for it would oblige them to take long walks over hills and through woods, in the sunshine and in the shade, to get these objects.

Knowing the great value of something of Natural History in the earliest stages of education, I should be glad to see it introduced into every school, not in the shape of lessons to be learned, but as forming the subject for many general lessons given in a conversational way, and leading to conversation in the school and at home.

It is now common, in many of the very best schools, for the teachers to give instruction — not merely to hear lessons — but to give real instruction; and there are few subjects in which more interesting and valuable instruction can be given than the several departments of Natural History; and few sources from which the best materials may be drawn more surely than they may from the numbers of the AMERICAN NATURALIST.

Very valuable instruction on these subjects has now for several years been given in the Normal Schools at Westfield, Bridgewater and Salem; and many of the teachers that have gone out from these schools are prepared to use, to excellent purpose, the knowledge given in most of the numbers of the AMERICAN NATURALIST. I have no doubt that, if the work were favored by the Legislature, the editors would see to it that there should be something of special interest to the teacher in every future number.

[*Remarks by W. H. Niles, Lecturer Mass. State Teachers' Inst.*]

Mr. W. H. Niles spoke of the NATURALIST as adapted to the use of the teachers of public schools. It differs materially from a text-book, and therein it has a feature of excellence. Text-books are condensed compilations, and are often written by those who have little or no experience as

original investigators. Frequently facts which are clearly related in nature are widely separated in such books, and thus, instead of elucidating the grand laws of nature, they too often become only volumes of disconnected statements. The teacher who assigns lessons from such books with no experiences of his own to add, can never lead his pupils to love and study nature. But in the articles of the NATURALIST we have original papers from professional naturalists, the direct results of the study of nature herself. These articles, in the hands of the teachers, would bring them genuine science fresh from its discoverers.

Again, the NATURALIST gives the latest results of scientific research. Natural History is advancing so rapidly that a text-book a few years old is necessarily wanting in many most important particulars. There must, therefore, be some medium of communication between the investigating naturalists and the teachers, to enable the latter to teach the science as it advances. The NATURALIST is the only publication in this country which furnishes such a medium.

But how are teachers to use the NATURALIST in schools? To assign lessons to be memorized from these or any other books on Natural History is useless. Many of the subjects presented in the NATURALIST are excellent topics for object lessons, and the articles would be very useful to the instructor in oral teaching. It is through such lessons and teaching that Natural History is to take her appropriate place in a thorough system of elementary education. To secure fresh knowledge, and scientific accuracy in teaching it, the NATURALIST should be used by the teachers of public schools.

[*Letter from Mr. Bennett.*]

LONDON, Dec. 1st, 1870.

TO THE EDITORS OF THE AMERICAN NATURALIST.

Sirs:—In the number of your admirable magazine for November, I observe that you do me the honor of reprinting

an article of mine, on the Cultivation of Foreign Trees and Plants, which appeared in the "Quarterly Journal of Science."

It has occurred to me that you might be glad to receive, from time to time, items of intelligence from this country, and the Continent of Europe, in Botany, Geology, and other branches of Natural Science, somewhat earlier than you would obtain them by reprinting from our journals. If so, I shall be happy to act as your correspondent in the matter.

I may mention that I have unusual opportunities of receiving such early intelligence, being sub-editor of "Nature," editor of the Scientific Department of the "Academy," and contributor of the botanical intelligence to the "Quarterly Journal of Science," which you have also often quoted in your journal.

Believe me to remain,

Yours faithfully,

ALFRED W. BENNETT.

[*Letter from Mr. Hiskey, Sup't of Public Schools, Minneapolis.*]

OFFICE OF SUPERINTENDENT PUBLIC SCHOOLS,
MINNEAPOLIS, MINN., Aug. 10th, 1870.

Editors American Naturalist:—Allow me to thank you for the August number of the NATURALIST. The numbers have seemed to me to be growing better and better and better, but this number is so admirably written that I have stopped to write you this letter after reading the first three articles. You, without doubt, have frequent expressions of commendation, still I imagine you have discouragements, and hence it gives me pleasure to express thus spontaneously, my congratulations that the NATURALIST is so admirably sustained.

Allow me to extend to you my best wishes,

And believe me, ever,

Yours truly,

W. O. HISKEY.

The following Notices of the Press were taken from several hundred notices of a similar character and laid before the Committee.

"The leading men of science in America are among its contributors, and it is in every way worthy of the great nation which it is intended to interest and instruct." — *Quarterly Journal of Science (London).*

"It deserves a wide patronage among teachers." — *Michigan Teacher.*

"The AMERICAN NATURALIST for June contains several excellent papers of a kind that are intelligible and valuable to others besides men of science. We regret that a publication so useful and so well conducted — so creditable to the country in every way — should not be supported liberally, as appears to be the case. The editors represent their expenses to be in excess of their revenue. We are glad to repeat that the NATURALIST deserves long life and the amplest development, and we especially regard it as of service to the young for inducing habits of careful and precise observation." — *The Nation.*

"We rejoice to see this beautiful magazine, and hope it will be the pioneer in a much-needed educational reform, and do good service in spreading a love and taste for the study of Natural History, now so utterly neglected." — *Massachusetts Teacher.*

"As a means of educating the people, especially the young, its efforts will certainly meet the approbation of all interested in the great cause of education, and we wish it abundant success." — *Maine Farmer.*

"This very ably conducted periodical is edited by a corps of young and enthusiastic naturalists, who, without departing from scientific accuracy, aim to make the study of Natural History so attractive as to win to it a more general and popular attention. It ought to be in every family and in every school library." — *R. I. Schoolmaster.*

"This Monthly Magazine of Natural History has won for itself a high place among the journals of the world. It knows how to popularize science without degrading it. Many of its articles are by some of the best zoologists of the country, and contain the results of original observation. The illustrations are always excellent." — Prof. J. D. DANA *in American Journal of Science and Arts, Jan.*, 1871.

"Science made easy is generally made absurd, and we have little patience with the somewhat popular belief that even small boys may be profitably dosed with science. But there are departments of Natural History, which can be treated popularly and yet scientifically. We have never had in our country a magazine giving *accurate* information on subjects of Natural History and, at the same time, bringing the information within the range of all, until the appearance of the AMERICAN NATURALIST. The editors are themselves accomplished naturalists, and devote their whole time to the study of nature. Hence their statements are entitled to entire con-

fidence. That the magazine is popular, and constitutes a charm for the whole family circle, we know from personal observation. Not only is definite knowledge gained from it, but habits of careful observation are formed. The young folks bring in their queer bugs and butterflies, and if they can not find out all about them and their habits in the magazine, they send the specimens confidently to the editors, and then wait and watch, oh, how eagerly, for the next number. The same with flowers or birds or shells. It matters little what enkindles thought and enthusiasm in the young mind. Once kindled they give light and power through the whole life. We can not too earnestly urge upon our friends to subscribe for the NATURALIST, and, having read the numbers, to bind and preserve them for future reference. They are as equally interesting and profitable for the "old folks" as for the boys and girls." — E. B. A., *in The National Teacher for March*, 1871.